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Engineering News-Record

Devoted to Civil Engineering and Contracting

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June 23, 1921

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

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The Case Proved

SUBSTANTIAL evidence that it is desirable to award highway contracts early in the season is contained in the 1919 and 1920 records of paved-road construction in Illinois, which are published on p. 1081. Often the assertion of the individual contractor that he requires two or three months to get into high production is regarded as a convenient excuse for possible failure to complete work. There can be no such suspicion of the records presented by Mr. Piepmeier, as they average the operations of a score or more contractors and perhaps a hundred paving outfits. Such averages are perhaps as nearly true as can be expected under the variable conditions in highway contracting during the last two years and they fully bear out the contentions so freely made by this journal and by highway authorities that volume in construction requires contracts to be let well ahead of the working season.

The Construction Situation

FOR the past two weeks analyses of contracts let, as reported in *Engineering News-Record*, show that the value of contracts let has exceeded those of the corresponding period of 1920 by more than 40 per cent. And no account in that difference is taken of the decrease in the cost of building within the past year, consideration of which would strengthen materially the per cent gain. New highway, street and miscellaneous building construction are far more active now than in June, 1920. Contract-value figures for 1920 were high in industrial work, where invariably the large projects are found, and this year there is almost a total lack of large industrial contracts. Outside of this, 1921 greatly outdistanced 1920 in number and value of contracts let. Construction is proceeding. Someone must be doing the work. Is it then true, that, while the papers are full of stories of agencies which are casting about for means to stimulate building, the extent of work being undertaken daily is overshadowed? Or is it true that each of us, accustomed to the abnormal prosperity of war years, cannot differentiate between such a condition and a normal one? The year 1920 was considered a good construction year. Yet we are spending much more now than at this time last year for new work. When the contractor, material manufacturer, or machinery dealer says business is far from normal is he thinking in terms of 1918 or of 1914? Perhaps we are nearer to a normal condition than we realize.

Pressure for Reorganization

THE President's ire has been aroused by the obstructionist tactics that are being exerted to prevent the reorganization of the Federal government, and Washington reports have it that he is letting it be known that those who indulge in such efforts will find themselves in disfavor. We hope he will put on pressure, put it on hard and keep it on right now, while his administration is young. Pressure now will be most effective, while Cabinet officers still have an inquiring and doubting frame of mind regarding the organization and efficiency of their departments. As we have expressed it editorially before this, government reorganization will come in this administration only if it is done quickly. Probably the best support the President can have is individual expression to representatives and senators that will show that the public demands a more effective government organization. The President can urge reorganization, but it will not be made effective unless the public backs his demand with its influence.

Cost of Acquiring Land

EVIDENCE of the present cost of condemnation and damages in acquiring railroad lands will be excluded in the valuation proceedings of the Interstate Commerce Commission if the bill now pending, to relieve the commission of the duty of finding these costs, is passed. As noted in the News Section, such a bill has been introduced in the Senate. Under this amendment to the Valuation Act, the commission would still be under the necessity of finding "present value" and original cost of lands, when they can be found, but it would be relieved from finding separately "present cost of condemnation and damages or of purchase in excess of such original cost or present value." Previously, the Interstate Commerce Commission declined to find and report these elements of cost on the ground that it would not be practicable to do so. It was then compelled to do so by the Supreme Court decision in the Kansas City Southern case rendered a year ago last March. If the present bill is passed it will vitiate that decision. In its proceedings to date, the commission has reported "present value" of lands (in reproduction cost) as the acreage value of adjoining lands. This journal and its predecessors have consistently recognized that cost of condemnation and damages are factors that should at least be admitted in evidence for determining cost of reproduction. The passage of the proposed amendment would be unjust to the carriers.

Uniformity Needed in Traffic Control

VEHICULAR traffic regulation has become an acute problem not merely in a few great metropolitan centers but in scores of medium-sized cities throughout the country. In the every-day life of manufacturer, merchant and citizen at large its influence is unmistakably felt, and as a consequence there has developed a widespread attempt at traffic control. Unfortunately there has been little co-ordination in this effort. Each locality is a law unto itself, and rules and regulations are being promulgated in one place, often by well-meaning but ignorant city officials, which are directly at variance with those of neighboring municipalities. Many of the

schemes are founded on illogical principles, are cumbersome and laxly enforced. Both motor vehicle driver and pedestrian, therefore, are confronted with a condition, not only highly confusing but essentially dangerous to life and property. Unless some central agency can be developed to secure acceptance, on a national scale, of sound and uniform principles of traffic control, the same crazy-quilt effect will be produced as now exists in the field of general motor vehicle and highway legislation, where the laws in one state bear little or no relation to those of another. Engineers, thus far, have stood aside and seen traffic regulation policies developed almost exclusively by police officials, aldermen and others without technical training. The present situation opens up a vast field for engineering study. The kind of work needed is that which can best be done by the highway or railroad transportation specialist. City traffic regulation should have a far more important place in the programs of engineering society meetings than it now occupies. It is not too late to bring order out of the chaos which now threatens, if engineers act promptly.

Individualism in Traffic Signs

STANDARDIZATION of traffic principles is only one phase of the broad subject treated in the preceding note. Uniformity should be extended to the signs, signals and other devices designed to regulate the movement of vehicles and pedestrians. Effective traffic control is dependent, first of all, on public understanding and co-operation, and if properly conducted, can be made very largely automatic. By collecting specimens from those cities where traffic regulation is active, it would be possible to fill a fair-sized museum with signs and signals, no two of which are unifrom as to size. shape, color, legend, etc. The polygot character of such an exhibit, if it could be assembled, would serve as the most convincing kind of testimony of the need for uniformity. While in some cities traffic directions are pitifully meager, in others there is danger of too zealous activity in placing signs and signals, with the result that the vehicle driver is faced with so many and so varied an assortment of directions that he abandons the attempt to read them and proceeds in his own way.

International Technical Meetings

AMONG the minor immediate consequences of the European war was the cessation of all international technical society activity. This particular means of promoting world fellowship and of advancing science had been growing rapidly in the first decade of the century and several important international meetings were planned for what proved to be war years. Naturally, they never took place, nor did the various associations function during the war years. Happily now there are signs of recovery. The Railroad Congress, which was to have been held in Berlin in 1915, is now scheduled for Rome in April, 1922, and the Road Congress, intended for Munich in 1916, will also be held in the Italian capital in the spring of 1922. There is meeting in Brussels now a committee to decide the date of the next Navigation Congress, which was to have taken place in 1915. So far the only one of the large international congresses not yet announced for the early future is that interested in testing materials. The last meeting was held in New York in 1912 and the next was scheduled for St. Petersburg in 1915. Some effort is being made to renew the functioning of this association, but nothing definite has yet taken place. The war's stoppage of international meetings must not persist too long. Engineers of every country can learn from their foreign confrères, and the promoting of good will and of interchange of information which reside in the international technical meeting is too valuable to lose.

Highway Financing Again

HIGHWAY financing in Arkansas is again brought to public notice by the U. S. Supreme Court decision, noted in last week's issue, p. 1052, reversing the judgment of the state court and sustaining objections on the part of two railways to the imposition of what were characterized as arbitrary and unreasonable assessments upon their property for the purpose of constructing 11 miles of gravel road. The levy on the railroads' 9.7 miles of right-of-way, at $7,000 per mile, totaled $67,900, an amount, the court held, so far in excess of the benefits accruing from the highway improvement as to amount to a denial of the equal protection of the law. The broad principle involved in the case is the one of just assessments for local benefits. It would be idle to argue that the construction of good roads does not appreciate the value of farm lands which they serve. Where direct benefits accrue, property should bear its just burden of cost. The point here, as staeted by the Supreme Court, is that certain property cannot be taxed upon some fanciful view of future earnings, while all other property is assessed solely according to area and position. In the case under discussion no basis on which the assessment was calculated was disclosed. Much criticism of the highway financing methods practiced in Arkansas has been heard recently. The present decision, while it involves special conditions in one state, should serve as a general warning against illogical and haphazard highway financing schemes which, while they may be temporarily successful in securing the construction of a few additional miles of highway, will, in the end, result in discrediting the cause of good roads.

England's Industrial Situation and Ours

ENGLAND never ceases to furnish more texts than any industrial preacher needs on almost every phase of industrial relations. Most of the texts are of the type on which "don't" sermons are written. Occasionally there is material for gratifying "do" preachment. Since the armistice the encouraging text has been more than ever rare, and we in this country are tempted to ask ourselves whether we must expect similar conditions. The subject is worthy of a little inquiry.

Industrially England's situation is almost chaotic. The long-drawn-out coal miners' strike could only occur in a country where industrial relations were in a bad way, particularly when all the normal methods of exerting the public's influence have been tried and found futile. That Englishmen themselves are deeply worried is evident from the repeated expressions that come from the other side. With characteristic English balance they hope for better things while picturing very black conditions. Such a picture was painted recently by E. J. P. Benn, the English publisher (see p. 1069 of this issue), while an equally frank view is presented by Sir Robert Hadfield, chairman of Hadfields, Ltd.

the great British steelmaking corporation. The sad part of these presentations, to an American reader at least, is that they offer no promising means of amelioration. The hopes expressed do not seem to rest on a sound foundation. An American is inclined to believe that England must go through some bitter experiences in industrial experimentation before more stable conditions can be looked for.

How is it with us? We, too, have industrial troubles —strikes in great number, arising from all manner of causes. Are we headed for an era of unreasonableness and of such maladjustment of industry as never to be beyond the shadow of a serious stoppage in some industry?

Unless all signs fail, we shall continue for a long time to have serious industrial disputes. Neither employers nor employees seem to be developing an attitude that is promising of great immediate good. But even if that be the case, we have in this country a situation that makes for harmony that is lacking in England. We have a group of citizens, not partisans to the industrial dispute, of such size that its views are likely to be decisive when the controversy begins to affect the general welfare. Of that group the farmers are the nucleus. They have shown repeatedly that they will not blindly nor permanently array themselves on the side of either industrial employers or employees. With them stand the so-called middle classes—the professional people, the small shop-keepers, and to some extent, office workers. In England this group, lacking a farmer element, is, compared with us, relatively small. There, one might say, there are only partisans in the industrial dispute. Here we have a great impartial jury. In fact it is the failure to reckon with that jury that has brought grief, at different times, to both sides.

In Europe itself this influence of the agricultural classes is apparent. The troubles of European nations are in proportion to their industrial populations. Our future difficulties probably will increase as we turn more from agriculture to manufacturing, but for many, many years we can count on a situation materially better than England's.

Cutting Wages to Fit Living Cost

IN THE last year there has been more wage-cutting—certainly more discussion of the subject—than ever before in the history of the country. This is quite natural, as never before was there such a period of inflation as 1916 to date. The debate rages around the question of how quickly wages can be decreased. That there must be a decrease seems to be the universal judgment.

Wholesale food prices have declined 48 per cent since the 1919-1921 peak, according to both the *Annalist* and the United States Bureau of Labor Statistics. Wholesale prices do not reflect the cost of living, certain authorities to the contrary. The cost of living is indicated by retail prices, and Labor Statistics show that retail food prices have fallen 31 per cent since the peak in 1920. But the foods group is only one of five in the workingman's family budget. *Engineering News-Record's* best thought reveals that family expenses have decreased 14 per cent since the summer of 1920.

Despite high rents and the fact that the restaurants have not shown recognition of the trend of wholesale prices, the cost of living is coming down. Obviously living costs cannot closely approach the pre-war level while labor continues to work on the 1920 basis. On the other hand, labor can hardly be asked to accept less than a living wage.

Fair adjustment of wages depends upon both an understanding and a recognition of the present status of the cost of living and of the rate at which it is descending.

Production vs. Wage Cutting

IN CONNECTION with wage cutting it is worth noting that we hear almost nothing now about output, about the production of the individual. At the close of the war, emphasis was laid on increased output rather than wages and it was freely contended that if output were increased it might be possible to maintain the war wage levels. Such contentions were sincerely made, but were probably much colored by the high idealism that held over from the war period. In many lines we have secured greater output. Both within and without union ranks performance is better, though non-union performance has naturally had the greater increase. Even in cases where output has doubled we seem to find it impossible—despite the good intentions of post-armistice days—to hold wages up. The facts are that economic law is gradually forcing us back to conditions more like those of pre-war than of war days. Discriminating buying is at the root of the change.

Also it is apparent that we did not get out of the war new stimuli for greater production. Probably there was progress in industrial relations in certain plants, but that progress was probably no more than what might have been expected had the war not come. In the aggregate, the movement has been a retrograde one. Notions of "right" have expanded into extravagant ideas, and the sum total is a demand of greater pay for less work.

Without a doubt the present depression, with its considerable unemployment, will tend to modify these extravagant ideas. That means is a brutal one, and in the minds of some the only possible corrective. It has, however, definite limits, and those limits are narrower now than before the war, because of the greater mass resistance to anything that seems to be of advantage to the employer. If, however, we are to check permanently the rising tendency in prices—which marched inexorably upward for twenty years before the war inflation—we must increase very materially the production per individual. It is the only assurance of plenty for all.

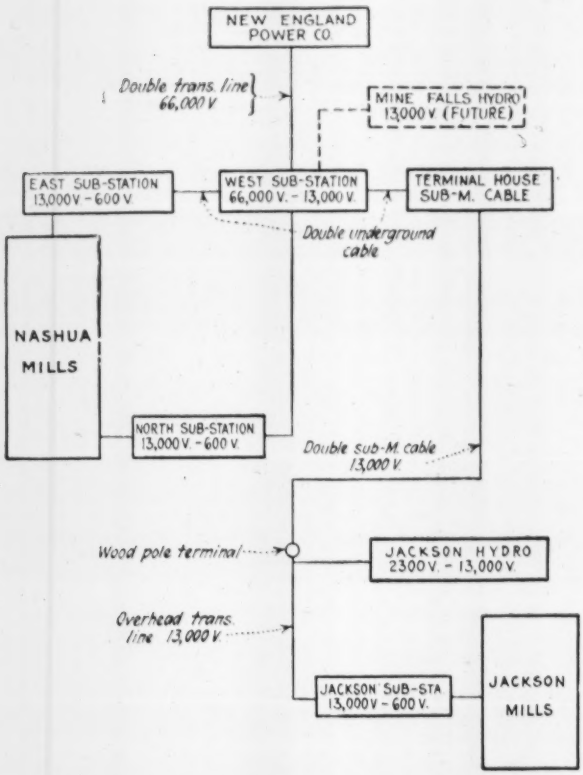
Production specialists have gone far in achieving the results they have sought, but methods and mechanisms will always be sorely handicapped until all workers, whether of hand or brain, accept the sound doctrine that only by large volume individual production can all be benefited. Following the war it seemed as if we were likely to have a general education of the public in this direction. Unfortunately the expectation has been fulfilled only in so far as distress and fear of unemployment have had an influence. In season and out it is the duty of all of influence, whether labor leaders, employers, engineers in industrial organizations, or others, to preach the doctrine of large production. And no sane man will object if the worker, of every grade, in accepting the doctrine demands that he shall have a good share of the fruits of his labor.

Rebuilding an Old New England Water-Power Plant

Special Construction Problems in New Hydro-Electric Station for Jackson Mills Long Supplied With Power From Individual Wheels Taking Water From Nashua River

By E. H. Swett
Hydraulic Engineer for John A. Stevens, Engineer, Lowell, Mass.

FOR many years the Jackson Mills of the Nashua Manufacturing Co., situated in the city of Nashua, N. H., have derived their water power from the Nashua River. The old plant consisted of a dam whose crest length is about 175 ft.; a canal one-quarter of a mile long, of about 900 sec.-ft. capacity and five sets of horizontal wheels located in the basements of the various mill buildings and totaling about 1,600 hp. In 1918 the decision to build a large, modern, reinforced-concrete mill building upon the site of a portion of the canal and adjacent old mill buildings necessitated the simultaneous construction of a new hydro-electric station. The process of transforming a series of individual powers into a central station in a congested


NEW ENGLAND POWER CO.
Double trans. line 66,000 V
MINE FALLS HYDRO 13,000 V (FUTURE)
EAST SUB-STATION 13,000 V - 600 V
WEST SUB-STATION 66,000 V. - 13,000 V.
TERMINAL HOUSE SUB-M. CABLE
Double underground cable
NASHUA MILLS
NORTH SUB-STATION 13,000 V. - 600 V.
Double sub-M. cable 13,000 V.
Wood pole terminal
JACKSON HYDRO 2300 V. - 13,000 V.
Overhead trans. line 13,000 V.
JACKSON SUB-STA 13,000 V - 600 V.
JACKSON MILLS

POWER LINE LAYOUT FOR JACKSON MILLS DEVELOPMENT

district involved a number of complicated construction problems.

The Nashua Mills of the Nashua Manufacturing Co. are situated on the Nashua River about half a mile upstream from the Jackson Mills. After an exhaustive study of the present and future power requirements, made in 1917, it was deemed most advantageous to electrify the Nashua Mills; develop the hydro-electric power to the fullest extent; make up the difference between power obtained at high- and low-water periods with steam electric power generated at the Nashua Mills, making fullest possible use of all byproduct steam in manufacturing, heating, etc., and finally to purchase all further power required from near-by public utilities. The Jackson Mills were already partially electrified, current having been supplied by steam turbo-generators and by generators driven by some of the old waterwheels. The electrification of the Nashua Mills was completed in 1917-1918, involving generators directly connected to the waterwheels.

Power Line Connection.—The water-power plant of the Nashua Mills consists of four sets of horizontal wheels, totaling 4,000 hp. with an operating head of 35 ft. The wheels are located in the various mill basements and supplied by means of penstocks leading from a canal. The headworks and dam are located at Mine Falls, about 3 miles above the mill. The full development of the hydro-electric resources contemplates the replacement of the present canal and wheels with a hydro-electric station at Mine Falls operating under a 50-ft. head and a transmission line to the mills. This is the last step in the development program, however, which, owing to the prevailing high prices of labor and material, has been indefinitely postponed.

To secure outside power from the New England Power Co. involved the erection of a 66,000-volt double-transmission line of wooden pole construction 18 miles long; 3 substations at various points in the Nashua Mills' yard, over 2½ miles of underground cable, 1,500 ft. of 13,000-volt double submarine cable and terminal house for same, one mile of 13,000-volt double-transmission line, and finally one substation in the Jackson Mills' yard.

There is shown herewith diagrammatically the relation of the new Jackson hydro-electric station to the system. By the proper use of disconnecting switches power can be sent from this station to either the Jackson substation or to the West substation.

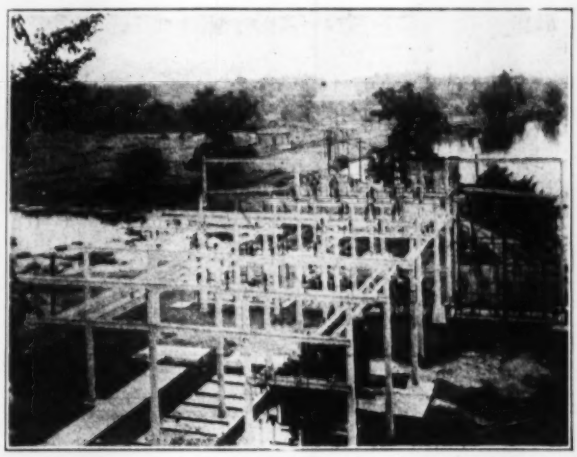
The West substation differs from the others in that it is of the outdoor type, consisting of reinforced-concrete poles with structural steel cross members. The manner in which these poles were carried down to firm foundation through quicksand is a construction feature well worth recording. The poles ranged from 25 to 32 ft. long and were cast on the ground with the reinforcing rods projecting 15 to 20 ft. beyond the base. Steel casings for reinforced-concrete piles were driven from 30 to 35 ft. to ledge at the site of each pole. The precast poles were picked up by the pile-driver, adjusted to proper elevation and alignment, with the reinforcing rods extending down into the steel casing. The pile casings were then filled with concrete. This method resulted in poles 50 to 70 ft. long with continuous reinforcement, although built in two sections. A view of the completed substation is shown.

The method of supplying the Jackson Mills' substation from the West substation in the Nashua Mills' yard was given considerable study. An overhead line would have to run through the heart of the city, with consequent complications concerning right-of-way, etc. The Nashua River, on the other hand, offered a direct

and unobstructed avenue of communication between the Nashua Mills and the Jackson Mills, which fact resulted in the selection of a combination underground and submarine system of power transmission. Accordingly two 500,000-cm. 3-conductor sector-shaped 13,000-volt cables were installed underground from the West substation to a point on the river-bank wall in the Nashua Mills' yard, where a small cable terminal house was built. The underground lines connect through disconnecting switches with a short section of uncovered buses in this building, which projects 15 in. over the river wall. Taps from the end of the overhead buses connect through potheads with two submarine cables.

These cables are 3-conductor, 0000, 15,000-volt armored cables 3½ in. diameter. They rest directly on the river bottom and run for a distance of approximately 1,500 ft. to the Jackson dam. They leave the river at this point on the opposite side from the hydro station and terminate in potheads carried on two wooden poles which mark the beginning of the overhead lines leading to the Jackson substation.

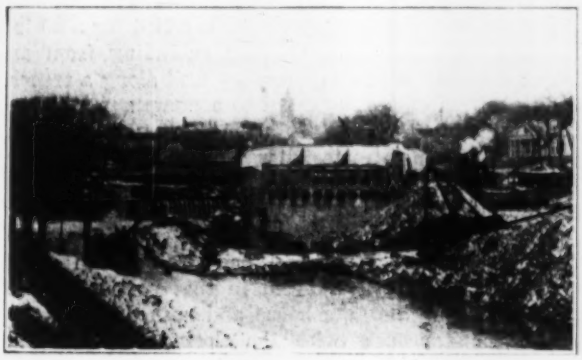
The installation of the cables was effected in the



REINFORCED-CONCRETE POSTS USED FOR WEST SUBSTATION

winter of 1919-1920. They were laid on the ice in the location desired and properly spliced. The ice was then sawed through and the cables allowed to sink to the bottom.

Power-House Equipment.—The Jackson station was designed to utilize the increased 10-hr. flow of the Nashua River which will result from the additional pondage to be developed at Mine Falls. The station will have an ultimate capacity of 4,200 hp., derived from three units. Only two of these units are installed at present, the third to be installed upon the completion of the Mine Falls project. Each unit consists of a 1,400-hp. S. Morgan Smith open-flume-type vertical wheel directly connected to an 880-kw., 2,300-volt, 60-cycle, 3-phase General Electric generator, operating at a speed of 100 r.p.m. Each unit is equipped with a Woodward oil pressure governor and a belted exciter driven from the waterwheel shaft. Owing to the slow speed of the unit this method of excitation was found to be more economical than the direct-connected exciter. Power generated at 2,300 volts is stepped up to 13,000 volts through a bank of three 1,100-kva. transformers, located at one end of the station, whence it



DREDGE EMPTYING INTO MOTOR TRUCK IN TAILRACE EXCAVATION

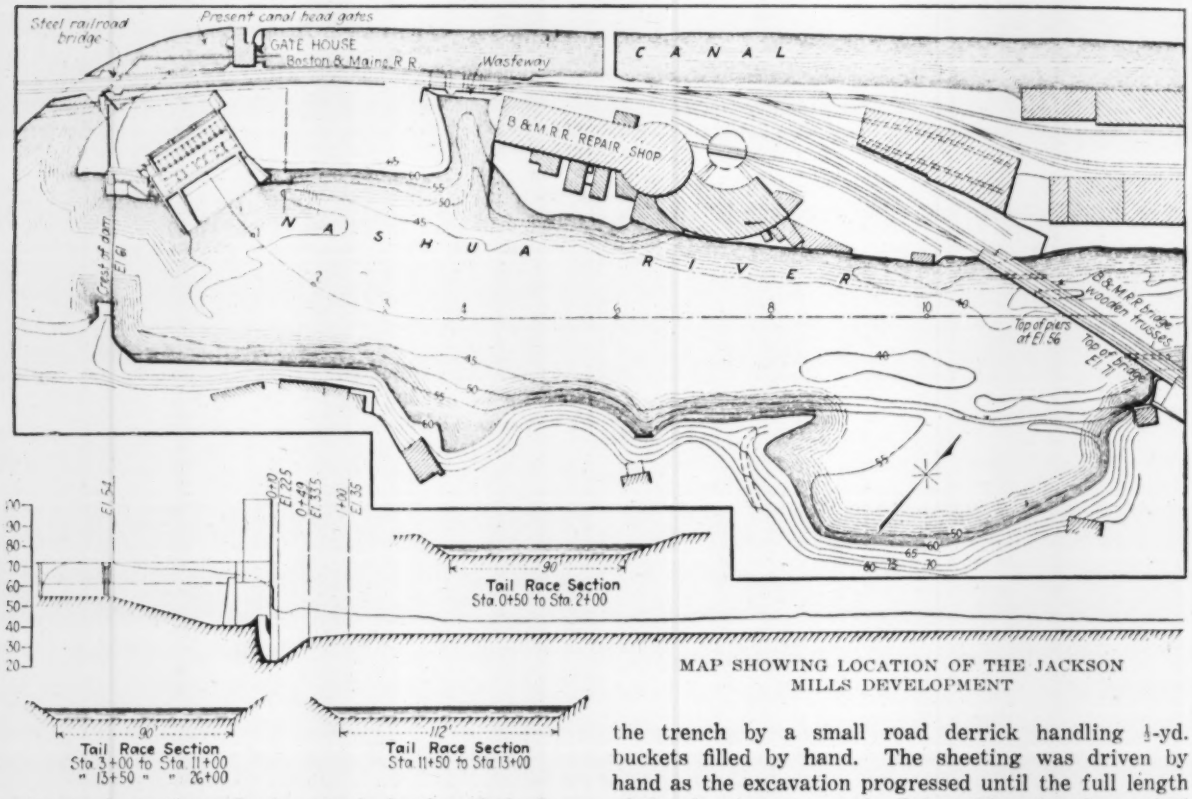
is conducted to a bus structure located in a switch gallery over the transformer room. To this bus structure are connected two Type H, 13,000-volt switches, each of which is located in an outgoing line extending to the overhead transmission line on the opposite side of the river.

The map shows a general plan of the development. The work in general involved the construction of a forebay wall of the gravity type parallel to the railroad and varying from 20 to 34 ft. in height; the excavation and lining with concrete of a forebay whose depth below normal water level increased from 7 ft. at the entrance to 21 ft. in front of the racks; the construction of a power house upon a rock foundation, and the excavation of a tailrace 1,000 ft. long.

As the Jackson Mills obtained its condensing and fire protection water from the old canal it was necessary to maintain this canal in operation as long as possible without seriously affecting the progress or cost of the work at the new power-house site. Excavation was, therefore, carried on behind the old canal wall running from the north abutment of the dam to the railroad right-of-way until the danger of a serious leak developing through the wall became a menace. The excavated material consisted of sandy loam overlying coarse gravel interspersed with large boulders. A ¾-yd. shovel dug the material, which was hauled away at first by teams and later, as the depth of the excavation increased, by five-ton trucks. The spoil was used in filling in a wasteway channel near the site of the work, in grading for a sidetrack, and later on in filling the old canal.

DERRICK WITH SCALE PANS TRANSFERS DREDGED EXCAVATION

The final plans for furnishing condenser and fire-protection water to the Jackson Mills called for a 30-in. cast-iron pipe line 1,500 ft. long extending from an intake chamber in the new forebay wall along a trench in the bottom of the old canal to a pump sump in the mill yard. By the time it became necessary to close the canal this pipe material was on the job. Closing was first effected by the stop logs and gates of the old gate house which was located across the canal about 150 ft. from its flaring entrance. As soon as the waste gate a the lower end had drained the canal work was immediately started in that portion of the pipe line below the gate house and rushed to completion. Simultaneously with the closing of the canal gates work on the cofferdam to drain the whole forebay site was started, and brought to completion by the time the pipe line below the head gates was finished. Work was then concentrated upon the intake chamber, adjacent portions of the forebay wall, and the remainder of the pipe line to connect the intake chamber with the completed portion of the line below the old gate house. A temporary wooden flume was built leading from an opening through the cofferdam to the intake chamber and the pipe line put into service at the earliest possible moment.


Steel railroad bridge
Present canal head gates
GATE HOUSE
Boston & Maine R.R.
Wasteway
C A N A L
B. & M. R.R. REPAIR SHOP
N A S H U A R I V E R
B. & M. R.R. bridge on wooden trusses
Top of piers at El. 56
Top of bridge El. 71
Tail Race Section
Sta. 0+50 to Sta. 2+00
Tail Race Section
Sta. 3+00 to Sta. 11+00
" 13+50 " " 26+00
Tail Race Section
Sta. 11+50 to Sta. 13+00

MAP SHOWING LOCATION OF THE JACKSON MILLS DEVELOPMENT

Construction of Power House.—The cofferdam finally constructed across the old canal entrance and tying into the north abutment of the dam consisted of a skeleton framework of 6 x 6-in. wales, 2 x 10-in. uprights and cross-braces, and ¾-in. tierods. The wales were spaced about 4 ft. apart vertically, with horizontal tierods on 5 ft. centers and uprights cross-braced every 15 ft. Eighteen-foot wales were used with diagonal lap joints. A tierod and cross-brace came at each joint, thus making the skeleton continuous and flexible. The framework was erected on a raft and as each section was finished the raft was pushed out from under. The cofferdam was filled with material taken from the power-house excavation and used as found with the exception that any large boulders were excluded. The side sheeting was simply placed in the framework and lightly nailed to the wales just ahead of the fill. Motor trucks filled the whole cofferdam by forming a ramp at the shore end and backing out over the finished fill.

Owing to the proximity of the railroad tracks excavation for about 100 ft. of the deepest portion of the forebay wall had to be carried down within well-braced sheeting. Three-inch sheeting and 12 x 12-in. wales and bracing were used. Material was removed from the trench by a small road derrick handling ½-yd. buckets filled by hand. The sheeting was driven by hand as the excavation progressed until the full length of the sheeting was used. Below this point the method of sheeting was as follows: A short section of the trench was excavated to a further depth of 5 ft., which was the distance between horizontal wales and a new system of wales and braces started. Five-foot lengths of sheeting were then tucked in behind the wales. The deepest portion of the trench obtained a depth of 25 ft. in this manner.

As soon as a section of the excavation was completed concreting was started and carried up in 5-ft. lifts. The bracing and wales were removed as the concreting progressed. The sheeting served as a back form on one side of the wall, while a proper batter was given to the front side of the wall by panel forms braced and wired to correct position against the front sheeting. While the wall was being built the power-house and forebay excavation continued, care being taken to leave a sufficient shoulder between the deep trench and the open excavation to take care of any thrust that might be transmitted through the bracing from the railroad side of the trench. With the completion of the

wall this shoulder was subsequently removed by the steam shovel.

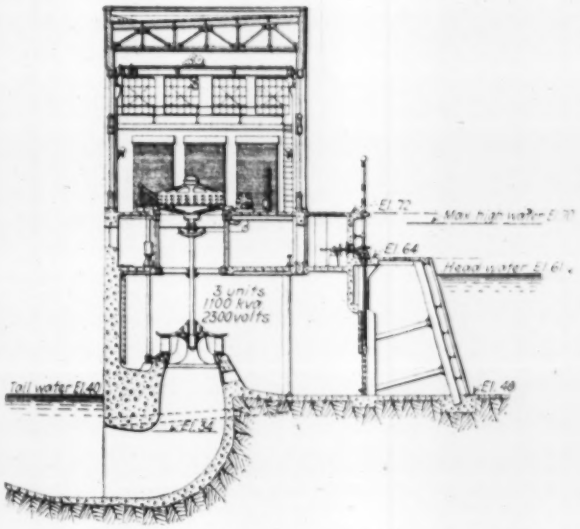
The power-house foundations were on ledge throughout, rock being encountered at from 2 to 5 ft. below the grade of the wheel chamber floors. The excavation for the draft tubes extended 15 ft. farther into the rock. Drilling and blasting was performed by a night shift and the mucking was done in the day time. The muck was removed by the steam shovel and dumped into skips. These skips were picked up by a stiff-leg derrick and emptied into trucks which hauled the material to the dump.

The draft-tube forms were built at a point about 100 yd. from the power-house site. The ribs were built from patterns drawn on a laying-out platform and accurately assembled in place in the skeleton framework by the use of longitudinal templates. Seven-eight-inch lagging was used, varying in width from ½ in. to 6 in. The forms were moved on skids and rollers to the edge of the excavation, whence they were picked up and swung into position by a stiff-leg derrick especially guyed and counterweighted for the purpose.

The concreting plant for the whole job consisted of one ¾-yd. mixer located under sand and gravel bins. The bins were served by a stiff-leg derrick equipped with a clamshell bucket which took the material directly from cars on the railroad siding or from the stockpile. Concrete was placed in the lower portions of the work by chutes suspended from a wire cable spanning the site. Side chutes conducted the concrete directly into forms or into buckets, which were then placed by a stiff-leg derrick. When the pouring had progressed to such a height that sufficient grade could not be maintained in the chutes the concrete was placed by buggies from runways.

Design of Power House.—A few features influencing the design of the power house, a cross-section through which, given herewith, may be worth mentioning. An unusual depth of water seal was provided for the draft tubes to make certain that should it become commercially desirable in the future to develop the few remaining feet of fall in the Nashua River near its confluence with the Merrimack by further dredging of the channel the seal would still be sufficient for the proper operation of the draft tubes.

A basement in the power house was found necessary to provide space for a heating plant, machine shop, storage-battery room, toilet facilities, etc. To have this basement floor above maximum high-water level would not only increase the cost but make the generator floor at an undesirable level. It was therefore decided to make the basement floor only 18 in. above normal headwater level and provide for uplift. This led to the adoption of structural steel framing for the generator and basement floors, and two trusses to run longitudinally through the basement. The generator and wheel loads, water thrust, and all other generator floor loads are carried on the top chord panel points, while the basement floor loads and uplift are carried on the bottom chord panel points. Proper rigidity and freedom from vibration was provided for by assuming the full load of generator, turbine and thrust to be concentrated at a single point of generator support at one time and designing the truss members accordingly. The wheel pit openings in the basement floor were closed by removable structural steel diaphragms provided with stuffing boxes in which the turbine shaft rotated.



CROSS-SECTION THROUGH THE JACKSON STATION

This consideration of having the basement floor well below maximum high-water level necessitated providing a water-tight wall on the forebay side of the basement. This was accomplished by the use of stuffing boxes on the shafts running through the wall to connect the main-line shaft of the headgate operating mechanism within the basement to the screw-stem-gate hoists located in the raking platform outside.

The excavation of the tailrace offered unusual difficulties, which, however, were successfully solved. The river below the dam flowed between high banks about 175 ft. apart. The normal channel followed the right bank, while an overflow channel followed the left bank, leaving a long narrow island covered with trees and undergrowth between the two and extending to the Boston and Maine R.R. bridge, which crossed the river about 1,000 ft. below the power-house site. The original plans called for widening and deepening the river channel for some distance beyond this bridge in order to develop the same head for the new station that the old wheels operated under. The consummation of the original plans would have involved the expenditure of a considerable sum of money on the piers and temporary bents which had been installed in the river bed to bolster up the rapidly deteriorating superstructure of the bridge, most of which would be thrown away upon the erection of a new bridge. As it is only a matter of a few years before the old structure will have to be replaced it was decided to postpone all work under and below this point until such time as the railroad is ready to carry out its replacement plans.

Building Tailrace.—Test pits and wash borings indicated that under the surface layer of boulders and river shingle the material was coarse sand and gravel. Two traveling stiff-leg derricks were accordingly installed and equipped with clamshell buckets, one working downstream and one working upstream. The narrow island along the middle of the river bed was especially favorable to this type of equipment and enabled the material to be deposited directly on each side of the river.

After the commencement of digging operation it became evident that the rate of progress would be in-

sufficient to complete the tailrace excavation by the time the power house was ready. A new type of equipment was therefore devised. A scow 40 ft. long and 27 ft. wide was built and launched in the deepest portion of the river and equipped with holding spuds in each corner. Upon one end of the deck was mounted a swinging and hoisting engine and 100-hp. boiler, while at the other was installed a bull wheel, A-frame, steam-shovel boom and dipper stick equipped with a ¾-yd. dipper. Later an additional boiler was added and the boom lengthened 8 ft.

This miniature dredge was successful from the start. It started operation at a point 400 ft. below the power house and traveled downstream, excavating a channel 30 ft. wide and to the full depth required along the right bank and depositing the material directly along the side. It then crossed over immediately upstream from the railroad bridge and excavated a similar channel along the left bank working upstream and depositing the material outside the channel as before. It was then floated back downstream and attacked the mid-portion of the channel. The material excavated from this mid-portion was deposited by the dipper into scale pans, which were picked up by one of the traveling stiff-leg derricks and swung over to the spoil bank on the right-hand side of the river. A view of this operation is given.

The stiff-leg derrick was mounted on three sets of wheels, one set under the mast and a set under each weight box. The wheels traveled on two lines of railroad rail and ties, one line of rail for the wheels under the mast and the other for the wheels under the weight boxes. When it was necessary to move ahead, a 30-ft. section of rail at the rear was unbolted, picked up by the boom with all ties attached and swung ahead into position and bolted up. The roadbed was prepared in advance by dumping an occasional scale pan load where needed instead of on the spoil bank. The derrick would then use the boom to pull itself ahead. In this manner 600 ft. of the tailrace was excavated. The downstream tailrace derrick was then dismantled and removed.

Meanwhile the excavation had so lowered the water level in the river that the water occupied only a narrow channel along the right bank from the dam down to the completed portion of the tailrace. This fact enabled the steam shovel which had completed the draft-tube and seal-pit excavation, to atack the tailrace at the upper end, working in the dry. The upstream tailrace derrick which had been handling the muck from the draft tube and seal pits continued to work with the shovel and dumped the scale pans directly upon spoil banks along the left-hand side of the tailrace.

The dredge then proceeded to excavate the narrow channel toward the dam to grade. A natural dike or roadway was left between the dredge operations and the steam-shovel operations. This dike extended from behind the upstream tailrace retaining wall connecting with the power house, paralleled the narrowed river channel and then swung over to the left bank. Motor trucks backing out along this dike, as shown in one of the views, removed the material excavated by the dredge.

By the time the dredge had proceeded far enough upstream the steam shovel had completed its operations behind the dike and climbed out of the hole. The pumps which had kept down the seepage were then stopped and the water allowed to rise behind the dike. The dredge then cut through the upper end and with the aid of motor trucks completed the tailrace excavation by removing the dike.

The depth of the tailrace excavation varied from 12 ft. at the upper end to 6 ft. at the lower. In all, 40,000 yd. were removed from the tailrace channel at a cost, including contractor's overhead and profit, of $1.78 per cu.yd.

The last feature of the project was the removal of the forebay cofferdam. Preparatory to this removal a stiff-leg derrick was erected on wooden piers in the forebay behind the cofferdam with the mast located so that all portions of the cofferdam came within the working range of the boom. The tops of the wood frame piers under the mast and weight boxes were well above normal water level. A platform was built over the top of the 30-in. pipe intake walls, upo nwhich were installed the derrick engine and boiler. The derrick was then rigged to operate a ¾-yd. clamshell bucket.

The forebay was filled through the opening in the cofferdam which supplied water to the flume running to the 30-in. pipe intake chamber. This flume was removed and the power-house gates closed preparatory to filling, and as the water rose the cofferdam framework was loosened as much as possible by removing the wales from the forebay side. After filling was completed the cofferdam material was cleaned out as much as possible, with clamshell buckets, and deposited by the derrick behind the forebay wall for back fill, and the balance taken to the dump by motor trucks.

Special precautions were taken at all times to guard against high-water damage or breaks through the cofferdam during construction. Any lowering of the water level above the dam would have broken the seal of the draft tubes of the Nashua Mills' wheels and deprived them of considerable power. No serious trouble was encountered.

The concrete work was performed by the Raymond Concrete Pile Co. in accordance with the designs and under the supervision of John A. Stevens, engineer, Lowell, Mass.

Log Rules Found Inaccurate in Mill Check

A comparison of log gagings by both the Doyle and the Scribner rules recently carried out for the Forest Products laboratory on a large sawing of red and white oak at Proctor, Ark., showed that both the rules are quite inaccurate. On small logs, up to about 20 in. diameter, both rules were well below the actual yield of the mill, by amounts ranging from 15 to over 30 per cent. The Doyle rule here gave the larger deficiency. At 22 to 24 in. diameter the yield of the white oak logs agreed fairly closely with both rules, but the red oak yield was still more than 15 per cent in excess of the rules. Approaching 30-in. diameter, the agreement of the rules with the red oak yield was fairly satisfactory, especially with the Scribner rule, which falls somewhat below the Doyle rule at about 28 in. in diameter. The sawing was one in a band mill. The red oak was plain-sawed, except in the case of the last quarter of exceptionally good logs, which were quarter-sawed; the white oak logs were in general plain-sawed up to 22 and 24 in., larger logs being quarter-sawed. Most of the sawing was to 1-in. stock.

Graphic Wattmeter Checks Gravity Plant Operation

Details of Distant Operations Indicated on Chart at Construction Engineer's Desk—Foremen Compete for Best Charts

IN PLACING 24,000 cu.yd. of concrete for a coke oven substructure at Milwaukee, Wis., the construction engineer checks every operation of a concrete gravity plant by means of a wattmeter graph which unrolls before his eyes. Delays, lack of co-ordination, underloading, plant defects and lagging work are positively indicated by the graph at the moment they occur and remedial action can be taken as promptly as the circumstances warrant. The graphic evidence when placed before the foreman curtails argument and excuses and sends them back to the job to obtain results. Besides the reason indicated, the construction is interesting because of its character and volume.

The old by-products coke ovens at the plant of the Milwaukee Coke & Gas Co. have been in operation over fifteen years. Last fall it was decided to replace these ovens with Koppers combination by-product ovens. As every available square foot of ground around the old batteries was used for operation and it was essential that the new work be done without interruption of the plant operation, the agreement was made that all engineering work and material be furnished by the Koppers Co. and the construction be performed by the engineering force of the Milwaukee Coke & Gas Co. In all 120 old ovens will be removed and replaced with 150 new ovens. This work has been scheduled so that 40 old ovens will be shut down at one time, these replaced by 50 new ovens and these ovens put in operation before the next set of 40 old ovens is shut down.

Many changes of railroad track, water, gas, steam and liquor piping, electrical wiring and pole lines had to be made before the first battery was shut down. When all the preliminary work had been accomplished, the first battery of 40 ovens was shut down and wrecking was commenced. About 700 tons of scrap iron were removed from this battery, loaded into railroad cars and sold direct to scrap dealers. The disposal of the old brickwork was accomplished by using railroad dump cars which were switched alongside the job and loaded with the help of one yard dump boxes and locomotive cranes, one on each side of the foundation. Fig. 1 shows the old concrete slab, dump boxes and locomotive crane in operation. In all 800 cu.yd. of concrete, 2,000 cu.yd. of dirt and 7,500 cu.yd. of brick were removed from the old battery.

The old concrete mat was on piles spaced 3 ft. on centers. These rows of new piles were driven alongside the old slab and a new slab 30 in. thick was poured over the new piles and the old slab. On this the new concrete foundations for the battery were placed. A total of 1,150 cu.yd. of concrete were poured in this new slab.

There will be about 8,000 cu.yd. of concrete in each battery foundation and 230 tons of reinforcing steel. The foundation for the stack contains 360 cu.yd. of concrete, the stack being 200 ft. high and 8 ft. in diameter.

The concrete mixing plant, was designed by the company engineers in conjunction with the engineers of the Boehck-Lowe Machinery Co. which furnished the equipment consisting of a 120-ft. steel tower, a motor-driven hoisting engine, a 28-ft. tilting mixer, a 120-cu.yd. slag and a 40-cu.yd. sand storage bin which were loaded by a ten-ton, 40-ft. boom, locomotive crane.

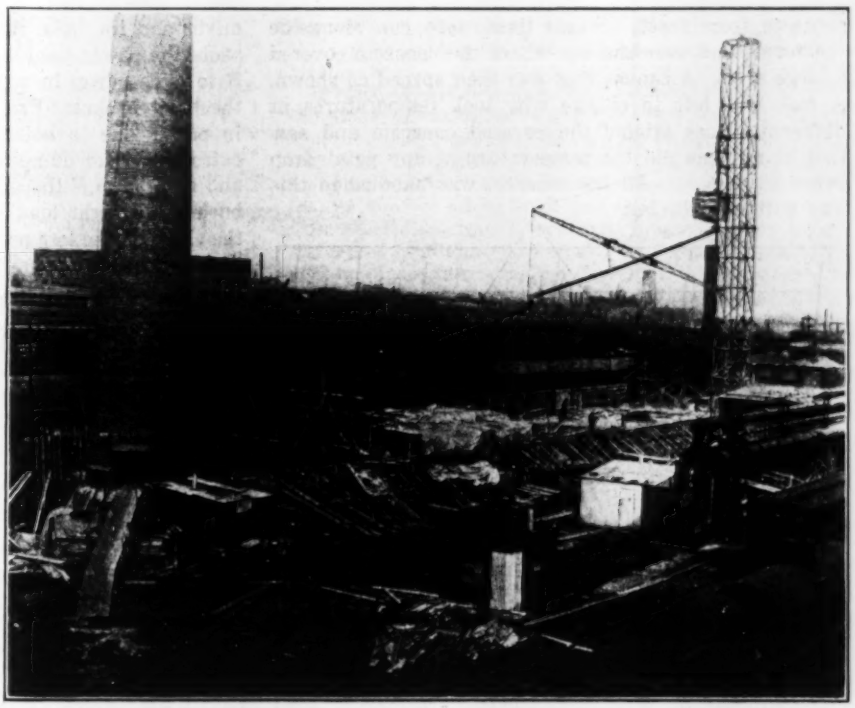


FIG. 1. GRAVITY PLANT WITH STRUCTURE TENTED OVER TO PREVENT FREEZING

Blast furnace slag was used instead of stone due to the heat resisting qualities of the slag. Experiments have shown that stone gradually disintegrates from the high temperatures to which these foundations are subjected thus reducing the life of the concrete.

Cement was wheeled directly from box cars to the mixer floor which was sheeted and arranged to store 1,200 bags. Sand and slag ran by gravity from the storage bins to a batch hopper where the cement was added. In this way a batch was prepared for the mixer while the previous batch was still in the mixer. Water was admitted to the mixer from two barrels through a 4-in. supply line. One barrel was being filled and heated while the other was dumping. The heating was done by the injection of live steam. It was found possible to complete a batch in 40 seconds and the best day's run was 480 cu.yd. in nine hours. Due to the weather conditions and the necessity of covering up the green concrete 250 cu.yd. per day was taken as the average run; this permitted the changing of chutes and the covering

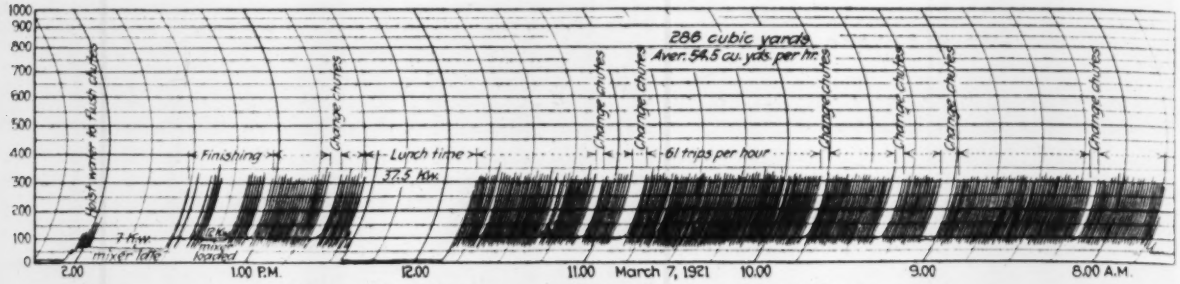


FIG. 2. WATTMETER CHART OF TYPICAL DAY'S OPERATION

up, as well as the actual pouring, to be done in an eight-hour day.

Fig. 1 shows the arrangement used to protect the concrete from frost. Steam lines were run alongside the forms and over the top where the concrete covered a large area. A canvas tent was then spread as shown. A man was left in charge who took temperatures at different places around the covered concrete and saw that at no time did the temperature at any point drop below 32 deg. F. All the concrete was handled in this way without freezing.

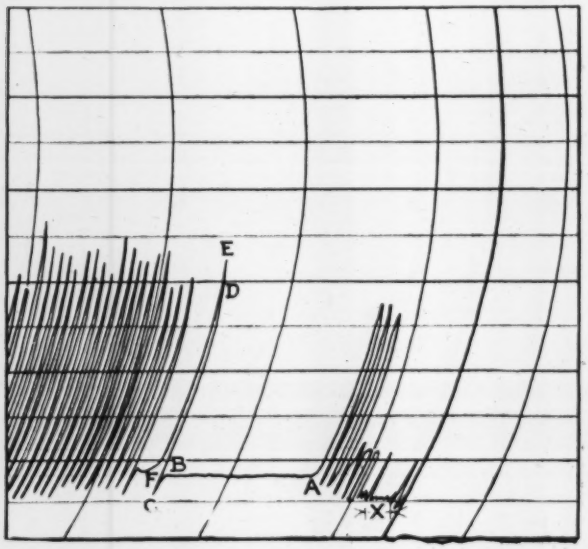


FIG. 3. DETAIL OF CHART ANALYZED TO INDICATE USE

The concrete gang consisted of one hoisting engineer, three cement handlers, two cement dumpers, one concrete mixer operator, one water tender, one tower man and seven men spreading the concrete and moving the chutes. One foreman was in charge of the whole gang.

As indicated by Fig. 1 the gravity plant was a standard boom type outfit. To follow the operation of this main plant unit, there was installed a graphic wattmeter with a 500-amp. shunt on a 250-volt circuit. The meter was placed close to the desk of the engineer in charge and enabled him to tell exactly how the concrete work was progressing at any minute of the day. One of the charts, a typical day's run, reproduced in Fig. 2, shows exactly how the work proceeded from the beginning at 7:30 a.m. until 1:30 p.m., at which time the day's pour of 286 cu.yd. was completed. It will be noticed that during one hour's run from 9:45 to 10:45 a.m., sixty-one trips were made representing 61 cu.yd. of concrete.

The smaller section of chart, Fig. 3, shows how the graphic record of the day's operation may be used. Thus, the section X shows the power consumed by the mixer and the hoist running idle; from *A* to *B* represents the power used with the mixer charged, and from *B* to *C* the drop in power when the mixer dumps into the hoist bucket. From *C* to *D* is shown the increase in power due to hoisting the load; from *D* to *E* the extra power for dumping the mix into the chute hopper, and from *E* to *F* the drop in power due to dropping the bucket. A light load can be immediately detected on the chart due to less power being consumed for hoisting. A defect in the dumping apparatus can be detected, the speed of operating the mixer and hoist can be determined and the actual number of trips made and the material used can be calculated. The engineer in charge can thus keep in constant touch with the operation of the plant and have graphic information to guide him in making changes toward producing greater efficiency.

The construction work is being done by J. Seton Gray and S. C. Peters, engineers for the Milwaukee Coke & Gas Co.

Railway Construction in Brazil in 1921

Because of the present transportation crisis throughout Brazil, the National Congress has authorized the government to construct new railway lines and to improve those already existing, the funds for the work to be secured by the ordinary federal revenue and by additional credit operations. According to the local press the present expense budget sets aside 2,000,000 milreis for the termination of the construction of the Sao Luiz to Caxias railway; 2,000,000 milreis for the prosecution of the construction on the Central of Piauhy; 1,700,000 milreis for the Petrolina to Therezina railway; 534,000 milreis for the Cruz Alta railway; 1,000,000 milreis for the Paranapanema Rio de Peixe line; 1,000,000 milreis for the Ararangua and Urussanga; and 1,500,000 milreis for the Mossoro railway, all for the account of the ordinary revenue receipts. For the constructions on the Great Western and the Rede Bahiana, bonds of the public debt will be emitted in accordance with the respective contracts.

Besides these expenditures, the budget is said to authorize the following expenses "for the account of credit operations or other extra resources": 2,000,000 milreis for the San Luiz to Caxias, intended for the large bridge connecting the island of Marahao to the continent; 1,000,000 milreis for the Central of Piauhy; 4,300,000 milreis for the Petrolina railway; 400,000 milreis for the Cruz Alta; 10,000,000 milreis for various lines of Rio Grande do Sul and the San Pedro de Alcantara to Uberaba; 900,000 milreis for the construction of the Central of Rio Grande do Norte; 3,000,000 milreis for a line from Massiaambu, in Santa Catharina; 4,000,000 milreis for the coal lines of Parana; 1,500,000 milreis for the Mossoro railway; and 2,000,000 milreis for the coal lines in Santa Catharina. These constructions reach the sum of 39,534,000 milreis.—*Commercial Attaché W. L. Schurz, Rio de Janeiro, Brazil, in Commerce Reports.*

Causes of the Economic Disturbances in England

By Ernest J. P. Benn
Of Benn Bros., Ltd., London

[*Mr. Benn's firm is the publisher of eleven technical and trade magazines. His article is an abstract of an address delivered last month before the New York Business Publishers Association.*—Editor.]

The thing that does not seem to be understood here (in America) is that we in England are absolutely steeped up to the neck in socialism. There are innumerable brands of it. You start with Bolshevism proper and work up to communism, collectivism, syndicalism, guild socialism, state socialism, and many other brands and varieties.

From the top to the bottom of society—and the more dangerous people are at the top, especially the women—these ideas have been absorbed: that business and profits and wealth are wrong. That sort of thing works its way out first in taxation which is, with us, not so much a matter of necessity as a matter of punishment for success. I understand you have an income tax. I have made a few inquiries about it and my impression is that you are infants in the early stages. You have no conception of the possibilities of this taxation business.

These ideas work out through the various branches of the labor organizations in such a way that it seems as if many of the workers have almost decided to do no work. This goes back to H. G. Wells, the man who is more responsible than any other. The fiction writers have a great deal of responsibility in the spread of propaganda for the simple reason that socialism has a sentimental touch which fiction loves.

But it is a mistake to suppose that our laboring class are actuated by any evil intent. I give them credit, full credit, for doing what most of them believe to be right. Their actions are due to a false conception of economics which starts upon the total fallacy that wealth is a fixed quantity; that there is a certain amount of money and work, and it is good business to prolong that business and make it afford work for three men where one was before. We must first eradicate false economics.

The Remedy

The remedy that is needful in our country is a big crusade on behalf of capitalism, capitalism properly understood. To begin with we need a synonym for "capitalism." It is a most unfortunate and misleading word. The word "capitalism" conveys to the minds of most people some system designed for the purpose of creating capitalists, individuals with great wealth, and in that sense it is an unfortunate word. We must drive it into the minds of our people that capitalism, the system of thrift, work and economy, is the only system which can care adequately for the lowliest. We must make it clear where we stand; that our faith in capitalism is due to our desire to benefit the whole community. And from that we must start out on a system of instruction in simple economics; simple economics, which, in our land at least, have long since been forgotten. Even our universities no longer teach the science of economics; the only thing that you can learn there is Sidney Webb-ics.

We must make it clear that capitalism is the only system in which the consumer stands a chance; that with socialism the producers stand as its logical end in rationing coupons, ques, and dictation from above or from below of the quantities and qualities and descriptions of comforts which we, as consumers, are to be permitted to enjoy. We must rub it home that there are four elements which are essential to successful industry and to successful civilization, and those *four elements are high profits, high wages, low prices and high production;* four elements which I commend to you, because I believe, if you will examine any instance in history of successful industrial enterprise, you will find those four elements always present.

We must come out and stand up boldly to justify profits; profits, like the magneto in a motor car, the one thing which through the ages has been the incentive to activity and the incentive to production. To suggest that civilization can continue without profits is in my humble judgment to suggest that which is totally false. You can no more carry on industry without profits than you can be born without a woman. In a free market the profit is the cheapest of the items that go to make up the cost of an article. Profits may be defined as a commission on economy, and no form of control in our old country yet discovered has proven half as economical as the most rapacious profiteer.

I do not want to give you the impression that I am too much of a reactionary. I am an individualist, but I combine with that a belief in organization, a belief in trade unionism, a belief in collectivism. But that makes me an optimist as to the future. We are passing through the early stages of collectivism misunderstood; collectivism misapplied. It is an error to suppose that collectivism and individualism are necessarily opposed to one another. The real sort of collectivism, the real sort of organization, is that which enables the individual to start from a higher plane.

If some of our reformers would put half the brains into the study of capitalism which they now waste in arguing about the unthinkable and proving the impossible they would find that the wisdom of the ages is not so mad as they imagine, and that there is still illimitable scope for the further good of all in thrift and work and economy.

In conclusion, may I say that I have painted a black picture of conditions in England, and I think it is a true picture of conditions as they exist at this moment. But it will come all right. It generally does come all right in our old country. We have a thing there of which we are immensely proud, an attribute that we call British common sense, and it has pulled us through many a crisis and it will pull us through this.

Fissured Rails

With increased experience in the detection of fissures in rails in the track the increasing number of fissured rails discovered has attracted attention to the potential danger of such defects. Investigations carried on for some time by Robert W. Hunt & Co., consulting engineers, Chicago, show that fissured rails discovered on various railways have been produced by various mills and subjected to widely differing traffic conditions, but detailed study of individual cases has failed to reveal any definite cause for the defects. Further study is thought to be desirable along the line of a comparative analysis of the numerous records already at hand, in an endeavor to find some common condition which may be a cause of fissures. The theory that fissures are due to stresses induced by excessive wheel loads does not appear to be fully supported by the evidence. Another theory is that they are due to abnormal conditions which occur without apparent reason during manufacture and which continue until discovered and corrected, thus affecting all rails of certain heats.

Next in importance to the prevention of fissures is their detection in the track. To assist in this the Hunt company has sent cards to roadmasters and other railway officers explaining the conditions, the signs of fissures and the necessity of close inspection to detect these signs. This company is also inviting such officers to inspect its collection of fissured and fractured rails. It has been pointed out that the action to be taken when a rail fissure is discovered in the track is a serious question, as all the rails of the same heat may be under suspicion. Removal of all these rails would be a drastic and expensive precaution, but the company urges that there should be minutely careful inspection of the other rails and frequent inspection (if not immediate removal) of such rails as show indications of fissures.

Wisconsin Experience with Day-Labor Road Construction

Fundamental Purpose of Force-Account Construction Was to Determine True Costs, the Records to Include All Base Cost Items of a Contractor's Estimate

By W. C. Buetow
Assistant Engineer, Wisconsin Highway Commission, Madison, Wis.

Last year the Wisconsin Highway Commission deemed it advisable to secure precise cost data on concrete road construction. Largely by arrangement with counties the Commission undertook several day-labor operations. The results justified the experiment financially, and also because of the practical information secured. The widespread interest exhibited in the experiment and the fact that the Commission will continue to conduct a certain amount of force-account construction each year led Engineering News-Record *to secure an authoritative account of the results obtained.*—Editor.

DAY-LABOR operations were undertaken in Wisconsin in 1920, either because no bids were received or because it was thought that the prices bid were too high. The recorded costs include all the items a contractor should include in his base figures of cost. The depreciation values used were arrivd at by a joint conference of Highway Commission representatives, county representatives, machinery men and contractors. They were used by the Commission in preparing estimates, and, presumably, by the contractors in preparing their bids. The percentages include not only depreciation but interest on investment, insurance, storage during idle times, and all repairs to the equipment. All percentages are applied on the original cost of the equipment.

Values were worked out on a basis of charging off certain percentages of the original cost per mile of 18-ft concrete pavement of the Wisconsin standard type, having a thickness of 8 in. at the center and 7 in. at the sides. For other widths and thicknesses it will be necessary to apply corrections to these values.

As an example of how the values were arrived at consider a paving mixer: It is assumed that the average paving mixer will build 30 miles of standard 18-ft. concrete pavement, at the end of which time it will be completely used up. The same depreciation would be obtained if we assumed that it would build 24 miles, at the end of which time it would have a salvage value of 20 per cent of the original cost. With the 30-mile figure, noted above, and an average mileage per year of 6 miles, the life of the mixer would be five years. The depreciation charge per mile then works out as follows:

	P. C. Orig. Cost
Depreciation in five years	100
Repairs in 5 yrs. at 10 per cent per year	50
Interest, storage and insurance over five years, at 6 per cent per year	30
Total charge for thirty miles	180
Charge per mile	6

Charges for grading machinery and hauling equipment, such as trucks and industrial railway, are percentages of the original cost per operating day. The percentages will vary with the kind of equipment used, the condition under which it is used, the number of earning or operating days per year, etc., but the proper percentages to charge will usually be betwen ¼ per cent and ½ per cent of the original cost per operating day.

The following is a list of the equipment used on the different jobs and the percentages of depreciation charged:

Item	P. C. per Mile
Camp and camp equipment	8
Pit equipment, crushers, etc	3
Bins, etc	7
Belt conveyors	12
12-ton road roller	2
Unloading equipment	4
Paver	6
Stationary paver	5
Pump and pipe line	6
Hose	20
Steel forms	12
Wood forms	27
Finishing machine	7
Hand concrete surface roller	20
Cement covers	10
Wheel barrows	16
Shovels	50

Cost data are valuable only when accompanied by a description of the methods used and of the conditions under which the costs were incurred. Table I is a comparison of the day-labor cost with the low bid received on each job and Table II shows unit costs on the day-labor work. Comment on the tables follows the descriptions of the separate operations.

Neenah-Oshkosh Road

When completed the Neenah-Oshkosh project will consist of 6.27 miles of Federal aid and 2 miles of state aid work or a total of 8.27 miles. Work was begun at the north end at Sta. 0 and carried as far south as Sta. 204, or 3.86 miles, which represents the 1920 work. Grading and paving operations stopped at the same point, so the road was in fine shape for travel during the winter.

Grading operations began about May 1, but ceased for a month during the summer as there was some doubt about getting aggregates for the concrete work. All excavation was with teams, using No. 2 wheeled scrapers. The roadbed was broken by a rooter and then loosed by plowing, teams being used for power in practically all cases. On the whole the cuts were shallow and the hauls were exceedingly long for this kind of equipment. In order to provide a suitable place to deposit the aggregates for paving the subgrade was excavated level to the interurban tracks and all excess yardage was dumped on the east side of the road.

Grading ahead of the mixer consumed 84 days and shouldering and ditching, after paving operations were completed, 34 days, or a total of 118 days for the grading operations for the season. The total yardage moved in that time was 12,453 cu.yd., at a cost of $1.45 per cubic yard. The shouldering cost 20.5c. per lineal foot of pavement. Teams were hired locally at $9 per 10-hour day. A portable barn was erected for stabling purposes and a camp was run for the grading crew only. All other crews were furnished transportation to and

from Oshkosh, Government light aviation trucks being used for that purpose.

The culvert work was principally patch work, consisting of lengthening existing structures or repairing broken end walls, and most of the culverts were placed with special drop inlets on the track side, where the center line of the road was so close to the track that an end wall if built would interfere with the interurban snow plow, which requires 5 ft. clearance outside the rail. No regular culvert crew was maintained, but men were used whenever they could be spared from other work.

Paving Operations

Paving operations were delayed until late in the summer, due to the delay in the early part of the season in getting a siding from the railway. Later in the season paving operations were not begun because of the embargo on freight cars used for hauling road materials. The Eastern Wisconsin Electric interurban line, operating between Neenah and Oshkosh, extends the full length of the project and was very favorably located for hauling materials.

At Sta. 383 the C. & N. W. Ry. cutoff to Medina Junction crosses the project at right angles to the highway. A double-end siding 1,100 ft. long, costing $2,377, was laid just west of the road. At the extreme west end of this siding a cement shed having a storage capacity of three cars was built to take care of large shipments of cement that could not be hauled directly to the road for immediate use. Material was unloaded from the railroad cars directly into 12-cu.yd. side-dump cars stationed on the E. W. E. Co. spur track, which paralleled the railroad siding. A caterpillar crane using a ½-cu.yd. bucket unloaded the material. It was not found necessary to stockpile any of the shipped-in material, as it could be hauled to the job as quickly as it was unloaded. The average haul for the season was 5.32 miles. The material was hauled to the road by the interurban work car, drawing four 12-yd. dump cars to the train. By stripping the lock on the dump cars the materials were deposited on the subgrade automatically without the use of air by having the load slightly overbalanced toward the road. When the subgrade was lower than the track the material when dumped cleared the rail of the interurban track so as not to interfere with traffic of passing interurban cars, but whenever the subgrade was higher than the track it was necessary to shovel the material away from the rail. This necessitated two men constantly to clear the track as quickly as possible.

All material was shoveled from the subgrade and wheeled to a four-sack paver. Four-sack or three sack batches were mixed according to the size of the crew. When deposited the concrete was leveled, struck off and tamped with a screed, then rolled, belted and finished by hand. The pavement was cured and covered in the usual way. When men were available two or three men covered the pavement, otherwise the whole crew covered each morning. The water supply was obtained from local wells and was pumped to the road through a 2-in. pipe line. Transverse joints were placed every 50 ft. Practically all of the cement was trucked from the railroad cars to storage, then rehandled and hauled to the job, either by truck or trolley. While this rehandling was expensive, it assured continuous operation with no delays waiting for cement.

The paving crew began to pour concrete July 21 and completed the work Oct. 4. During that time there was a total loss of five days due to rain, one day due to lack of labor and one day taken off for the County Fair. The total number of working days spent in paving, counting all fractional days as full days, was 57. The average amount of pavement laid for each of these days was 358 lin.ft., or 716 sq.yd. From Sept. 8 to Oct. 4 the pavement was completed from 118 + 44 to 204, an average of 428 lin.ft., or 856 sq.yd., per day. The maximum run for one day of 10 hours was 528 ft., or 1,044 sq.yd. The pavement was 18 ft. wide, 7 in. thick on the side, 8 in. in the center and of 1:2:3½ concrete.

The labor organization is shown below with the wages that were paid at the close of the season.

Unloading and Hauling Aggregates	Rate Per Day
1 clamshell operator	$7 50
2 men cleaning up cars and moving them to clamshell	6 00
1 man leveling dump cars	6 00
2 men spotting material and keeping material away from electric line to give clearance to interurban cars	6 00
Cement	
Three trucks were used to haul cement, driver and one man on each truck	6 50
When electric line was used to haul cement, trucks were idle and drivers and helpers handled cement	6 50
Mixer	
16-20 men shoveling and wheeling material into mixer (usually there were 5 men on sand, the rest were on stone)	6 00
3 men on subgrade	6 00
2 form setters	13 00
1 mixer operator	7 00
1 mixer fireman	6 25
1 mixer dumper	6 25
2 puddlers	6 00
2 on strike board	6 00
1 finisher	6 50
1 pump man	6 00
1 water boy	2 50
1 man wetting concrete	4 50
When available 2 to 3 men covered the concrete with earth; otherwise the whole crew covered each morning	6 00
General	
1 team with driver and extra man kept subgrade ahead of mixer in shape with small grader; also hauled the forms ahead each day and did other small jobs	15 00
Superintendent was in direct charge of paving operations, per month	200 00

The total yardage moved in grading was 12,453. Grading operations consumed 84 days grading ahead of the mixer and 34 days shouldering, a total of 118 days. The organization was as follows:

	Rate Per Day
Foreman in charge of grading, month	$175 00
2 men holding wheelers	5 00
2 men dumping wheelers	5 00
2 men staking ahead or trimming behind other operations	5 00
1 man running grader	5 00
2 plow teams	9 00
1 snatch team	9 00
6 to 10 teams on scrapers, depending on length of haul	9 00

Milwaukee-Fond du Lac Road

In Washington County the day-labor operations were a continuation of the concrete road from Germantown north on Route 15, toward Jackson. The total length of pavement laid during the season was 3.77 miles. Contracts were let for bridge and culvert work and for hauling the materials, but the production of the aggregates, the grading and the paving were by day labor.

Aggregates were produced in a pit about one mile north of Jackson. The material was excavated with a stiff-leg derrick and clamshell and loaded into small dump cars which were drawn up a trestle, by a hoist and cable, to the screens. The material was washed and separated to proper sizes, the small amount of oversize stone being discarded. It was hauled to the road by trucks and dumped in stockpiles on the subgrade. The average haul was 7.5 miles.

During paving the material was shoveled from the subgrade and wheeled to a four-sack paver. The concrete when placed was struck off to the proper crown by a screed, and the surface was rolled and finished

by hand. The pavement was then covered with earth and wetted thoroughly until properly cured. The slab was 18 ft. wide, 7 in. and 8 in. thick and of a 1:2:3½ concrete. Joints were placed every 50 ft. The grading was made difficult because of the number of large boulders in the subgrade and ditches. Also the subgrade was of such a nature in low places that it was difficult to haul materials over it. The organization for the work was as follows:

Grading	Rate per Day
1 foreman	$7 50
1 man on dump	6 50
1 man loading	6 50
1 hoist engineer	6 00
5 teamsters on wheelers	5 00
2 plow teams ers	5 00
3 men on dump	5 00
1 man on cable	5 00
1 cook	5 00
1 helper	3 00
1 water boy	2 00
7 teams	5 50
1 horse on cable	2 75

Note—Board, cost $1.67 per day, added to above rates.

Pit Operations	
1 foreman at pit, per month	$250 00
1 derrick operator, per month	250 00
1 hoist engineer on trestle	7 50
1 pump man	6 50
1 man dumping cars	6 00
1 man tending hopper	6 00
1 man spotting cars	6 50
1 man tending sand hopper	6 50
1 traction engine and man, per hour	1 60

Note—Board was not furnished to this crew.

Paving:	
16 men shoveling or wheeling	$5 00
2 men handling cement	6 00
3 men on grade	5 00
3 puddlers	5 50
1 strike board man	5 50
1 strike board man	7 00
1 mixer operator	9 00
1 form setter	10 00
1 form helper	5 00
1 cook	6 00
2 flunkies	5 00
1 water boy	2 50
Foreman, per month	300 00
1 Finisher	9 00

Note—Board, cost $1.67 per day, added to above rates.

JANESVILLE-EDGERTON ROAD

A central mixing plant was used. Good gravel deposits were located along the project at convenient points just off the highway. The first section of the road, 9,080 ft. in length, was completed from the first set-up opposite Sta. 68. Weather conditions shut down the work after 6,751 were laid from the second set-up.

Materials were excavated with a power scraper operated by a hoist and cable. A jaw crusher reduced the oversize gravel to proper size, the fine material passing through a grizzly directly to the elevator. The bins were designed to be knocked down and re-erected at the various pits. A five-sack stationary mixer was placed directly in front of and lower than the bins so that the mixer could be charged by gravity. An industrial railway hauled the mixed concrete from the plant to the road. A train, composed of three cars, two five-sack batch boxes per car, was hauled by a three-ton gasoline locomotive. Three trains were used. The boxes were lifted from the cars by a road crane on the subgrade. After dumping the batch box was cleaned out by compressed air. A finishing machine was used on the entire work. The first section had a joint every 50 ft., but the second section was built without joints. On account of the stony nature of the excavation straw was used to cover the concrete. The curing was done in the usual way, by wetting thoroughly for a period of two weeks.

At the second set-up a steep grade leading from the pit required the assistance of a pusher engine to get a train load to the road. Each engine in turn spotted its train of empties at the mixer and acted as a pusher to the train ahead. One pump was not capable of furnishing enough water pressure for the mixer and also for curing purposes, so an additional pump was placed in the line. The pit layout at the second set-up, which furnished material for the road from 108 + 49 to 176, was by far the better of the two and an additional feature was elevating the cement to the hopper of the mixer by a belt conveyor. The cement was emptied into a hopper at the cement platform. At both pits there was a large excess of sand and a man and team were employed to haul this sand to a waste pile.

The grading was contracted at $1.10 for the rough grading ahead of the mixer. The shouldering was done by day labor and cost $0.20 per linear foot for both sides. The culverts were built by contract.

The record run of the year for the job was 504 lin.ft., and the average for the season was 510 sq.yd. per operating day. The average haul was 0.65 miles. The organization was as follows:

Pit	Rate Per Day
Pit foreman	$9 00
Hoist operator	6 00
2 men on crusher	6 00
1 pit man	6 00
1 traction engine operator	6 00
1 team hauling waste sand	10 00
1 man driving team	6 00
2 men in sand bin	6 00
Paving	
3 truck drivers (cement)	6 00
3 truck helpers	6 00
2 pump men	6 00
1 man on service car	5 00
1 man in charge of locomotives	7 00
2 dinky drivers	6 00
1 crane operator	7 00
1 mixer operator	7 00
2 men handling cement	7 00
1 mixer fireman	6 00
1 mixer dumper	6 00
1 sack baler	6 00
1 man on finishing machine	6 00
3 puddlers	7 00
1 man dumping batch boxes	7 00
1 man cleaning and taking off forms	6 00
2 form setters	6 00
2 men on grade	6 00
1 finisher	6 00
1 team	10 00
Extra man with team	6 00
Boy wetting concrete	3 50
Engineer on job, per month	200 00
Timekeeper and purchasing agent, per month	200 00

DISCUSSION OF TABLES

A few words in explanation of the unit costs shown in Tables I and II are desirable:

Neenah-Oshkosh Road.—The cuts were light and the hauls were too long for No. 2 wheelers, which were used on this work. On account of the interurban track lying so close to the roadbed and to facilitate dumping the aggregates from the 12-yd. dump cars the shoulder material had to be placed on the far side in order to leave the subgrade alongside the track perfectly clear.

The culvert cost really cannot be compared with the low bid price, which was for standard culverts, as shown on the original plans. As stated in the history of the job, the end of the culverts next to the track had to have special inlets. This necessitated intricate forming and excavation for a small yardage of concrete. Had the work been done by contract a special agreement would have been entered into to take care of this special work.

In addition to this, had there been a crew organized and kept continuously on this work the labor and over-

TABLE I. COMPARISON OF DAY LABOR COSTS WITH LOW BIDS

Item	Winnebago County — Neenah—Oshkosh Road				Washington County — Milwaukee—Fond du Lac Road				Rock County — Janesville—Edgerton Road			
	Quantity	Cost	Day Labor	Low Bid	Quantity	Cost	Day Labor	Low Bid	Quantity	Cost	Day Labor	Low Bid
Grading	12,453 c.y.	$1 45	$18,063	$1 25	$15,566	17,194 c.y.	$1 43	$24,633	$1 22	$20,976	12,859 c.y.	$1 346	$17,319	$1 25	$16,073
Culvert	112 c.y.	41 62	4,661	25 00	2,800	115 c.y.	27 00	3,105	25 00	2,875	164 78 c.y.	19 38	3,194	29 40	4,844
Paving	40,842 s.y.	2 42	98,923	3 02	123,343	39,775 s.y.	2 80	111,411	3 08	122,507	31,627 s.y.	2 08	65,915	2 65	83,812
Total			$121,647		$141,709			$139,149		$146,358			$86,428		$104,729
Total per mile			$31,515		$36,712			$16,809		$38,821			$28,809		$34,909
Total saving			20,062					2,209					18,301		
Saving per mile			5,197					1,912					6,100		
Saving paving only			24,419					11,096					17,896		
Total per mile paving only			25,627		31,954			29,551		32,495			21,971		27,932
Saving per mile			6,326					2,943					5,965		
Miles of road built			3 86					3 77					3 00		

The above day labor figures do not include the items of taxes, bond and liability insurance. A contractor must add these values to his base price. For the Neenah-Oshkosh work these items amount to 3.89% of the grading cost, 2.40% of the culvert cost and 2.41% of the paving cost. For the Milwaukee-Fond du Lac work the percentages are 3.95% of the grading cost and 2.73% of the paving cost. For the Janesville-Edgerton work the percentage is 4.32% of the paving cost.

TABLE II. UNIT COSTS OF FORCE ACCOUNT ROAD CONSTRUCTION IN WISCONSIN

	Winnebago County — Neenah—Oshkosh Road				Washington County — Milwaukee—Fond du Lac Road				Rock County — Janesville—Edgerton Road			
	Yardage	Cost per Cu.Yd.	Cost per Sq.Yd.	Total Cost	Yardage	Cost per Cu.Yd.	Cost per Sq.Yd.	Total Cost	Yardage	Cost per Cu.Yd.	Cost per Sq.Yd.	Total Cost
Right of way				$100 00				$7,727				$219
Culverts	160 c.y.	$41 62		$6,659	181 8 c.y.	$27 00		4,908	164 78 c.y.	$19 38		3,194
					133 0 c.y.	31 58+	(Bridge extras	4,200 366				
Grading	12,453 c.y.	$1 45		$18,062	17,194 c.y.	$1 43		$24,633	12,859 c.y.	$1 346		17,319
Paving	40,842 s.y.				39,775 s.y.				31,627 s.y.			
Material in bin or siding	(Siding)	$2 30	$0 674	$27,507	(Bin)	$1 44	$0 515	20,623	(Bin)	$1 49	$0 43	13,586
Cost of unloading	11,748 c.y.	0 31	089	3,642								
Cost of siding		099	234	9,575								
Cost of hauling		716				1 67	60	23,884				
Mixing and placing			469	19,144			796	31,638			0 832	26,309
Cement-storage-hauling	13,711 bbl.	$2 81 bbl.	944	38,559	12,836 bbl.	2 73 bbl.	882	35,067	9,862 bbl.	2 63 bbl.	822	25,990
Contingencies			012	496			005	198			001	30
Total			$2 422	$98,923	Total		$2,798	$111,410	Total		$2 085	$65,915
Sack loss per sq.yd. (included under cement)			$0 0016				$0 0019				$0 0015	

head could have been materially reduced. The culvert crews acted as a replacement division and furnished men temporarily for other work during the period of uncertain rail deliveries.

Milwaukee-Fond du Lac Road.—On this job the grading operation shows a loss. This part of the state is densely settled and the fence lines are close together. This feature made it very difficult to get shoulder material and to dispose of the large amount of big boulders encountered.

The paving operations on this road were rather a disappointment. The county men in charge set a 300-ft. mark as the day's operation. No matter what time of the day this mark was reached the crew was done. His idea was that the crew would "get to going good" sooner after paving operations started and have some object in view to push the work. The mark was set altogether too low and the costs show it. The wages paid were higher than were absolutely necessary to secure and keep the labor.

Janesville-Edgerton Road.—There were no unusual conditions encountered on this work. The rough grading was done by contract and the shouldering by day labor.

On the culvert work the county furnished the cement and steel and contracted for the balance. In Table II the unit cost of aggregates in the bin for the Washington and Rock County operation is based on the yardage actually hauled and does not include the material wasted at the pit. The waste in the Washington County pit was quite small and consisted of large stones only. The amount was not sufficient to warrant a crusher operation. In the Rock County pits the sand content ran quite high and necessitated the handling of a large yardage in waste.

Concrete Roads in London

(London Correspondence)

In all, about seventy concrete roads are in use in this country, the majority of which are successful. In the cases of those roads which are not it is the general opinion of the Ministry of Transport that failure is due rather to bad workmanship than to faulty design or material. There is no doubt that road and concrete machinery will eliminate most of these failures.

Concrete as a road surface material is being used extensively in and about London. One south London borough, for instance, has reconstructed as many as twenty-five of its roads during the past two years with concrete and is about to begin on another fifteen. Macadam material, when removed from the road surface, is passed through a washing and grading machine to form the aggregate for the new concrete road.

The new north circular road will be 100 ft. wide over all, made up as follows: 16-ft. footway, 24-ft. roadway, 20 ft. to be reserved possibly for a tramway or high-speed traffic, 24-ft. roadway, 16-ft. footway. At first only one section of this road, the first 24-ft. roadway, is to be constructed. On this section the roadway will be of two layers, 1 bottom course of 5 in. will be of concrete 6: 1, the aggregate to pass through a 2-in. seive but to be retained on ¾ in. The top course, of 3 in., is to be of concrete 3: 1 aggregate ¾ in. These dimensions and proportions are provisional and may be altered. Moreover, a space of 4 in. will be left on top of the roadway which will be filled with a wood or asphalt paving should the concrete surface fail. Mr. Dryland, the county engineer of Middlesex, says the success of this road depends upon its ability to carry the heavy traffic which will be diverted from the main highways of London city itself.

Combination Quay and Pier Built in Restricted Space

Unusual New York Harbor Layout for Irregular Area—Concrete Cylinder Foundations on Sloping Rock Ledge—Two- and One-Story Sheds—Track Connections at Wings—Steel Frame Construction

COMBINING elements of quay and pier, a new waterfront development for Ellerman's Wilson Line is nearing completion at Castle Point, Hoboken, N. J., at the narrowest point of the Hudson River in New York Harbor. To make full use of an irregular, restricted space, with the pierhead line only 210 ft. from the marginal street, the layout is somewhat unusual, including a pier side 296 ft. long and a quay 950 ft. long, carrying a two-story shed with one-story wings as storage areas for railroad transfers. The pier is built adjacent to a high rock bluff, and it was found necessary to provide concrete foundation cylinders on about one-third the length of the quay front to carry the structure on the sloping rock ledge for lack of sufficient penetration in suitable material to hold piles. The substructure is of the usual pile and timber type, with concrete deck and pile foundation clusters cut off at about mean tide and capped with concrete carrying the superstructure columns. The sheds are of steel-frame construction, with galvanized-iron siding and steel sash. Rolling steel doors are located continuously on the face of the quay at both stories and on the pier side, and also at both wings on the marginal street where they adjoin the tracks of the electrically operated Hoboken Manufacturers' R.R.

Prior to this development, the Wilson Line occupied only the one-story shedded pier immediately southward. For extension to the north the only space available was a narrow strip with wings at each end, then partially occupied by a ship-repair plant, with the waterfront undeveloped. With the established pier-head line only 210 ft. from the shore shed limit, the quay face was established 100 ft. back of the pier-head line for protection of ships while berthing. With this restricted area it was desired to use a two-story shed, but to simplify construction and to utilize fully the wing areas, one-story sheds were adopted for the wings, these to serve as storage and transit areas for the transfer of freight between pier, dray, and cars—the two-story shed extending for the entire 940 ft. length, 100 ft. wide.

Because of the difficulty of securing proper approaches, no attempt was made to carry the tracks onto the pier. However, new front tracks were laid along the street at each wing with capacity for five and seven cars, respectively. To insure that the doorways will not be permanently blocked no unloading platform is provided, the tracks of the electric railroad being laid in the paved marginal street. Each wing will be used

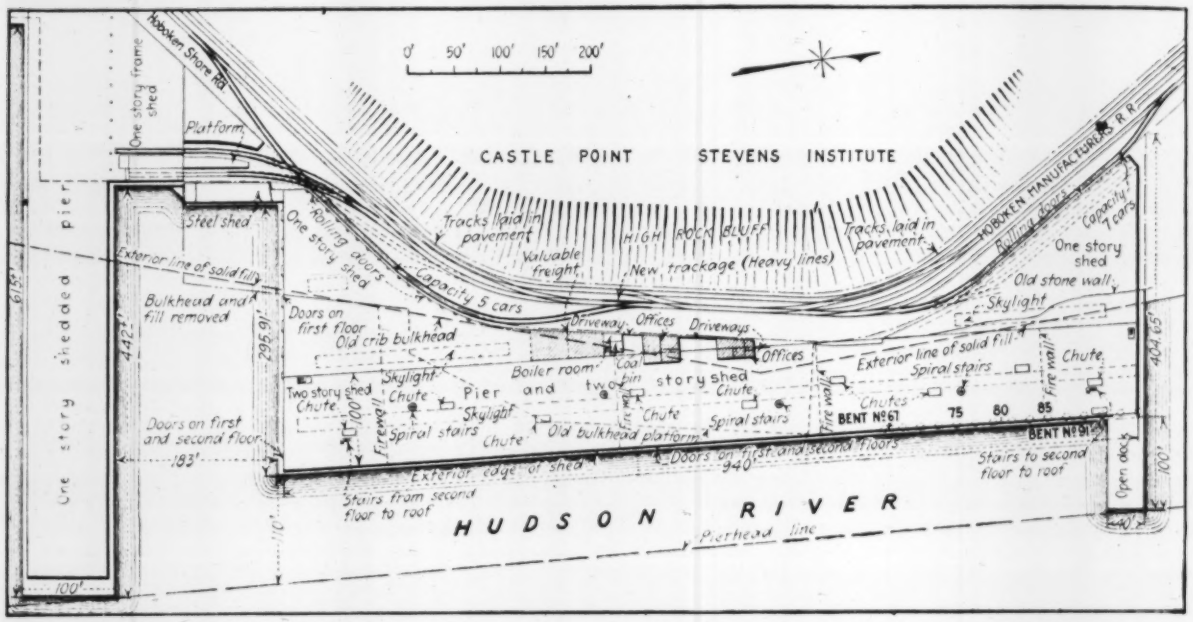


FIG. 1. WATERFRONT LAYOUT FOR WILSON LINE COMBINES ELEMENTS OF BOTH QUAY AND PIER

both for inbound and outbound movement. It is intended to operate the transit area largely by tractor trailers. The second story will be used practically entirely for inbound light freight from steamers. This light freight will be delivered to the first story or to trucks and drays by the nine cargo chutes, located as shown in Fig. 1, representing the plan layout and trackage. A swinging cargo beam, 75 ft. above mean low water, traverses the entire length of quay front and two-story portion of pier side. Nine electric winches will be placed at intervals along the quay front and pier side to work in connection with ships tackle and cargo-beam operation.

Access for drays and trucks is provided by four doorways on the street side, in addition to the thirty-six doorways at the wings which may be used for dray service if cars are not loading or unloading. The receiving and delivery offices are located on either side of the main driveway.

As shown in Figs. 2 and 3, the superstructure is of ordinary steel-frame construction with sides of No. 22

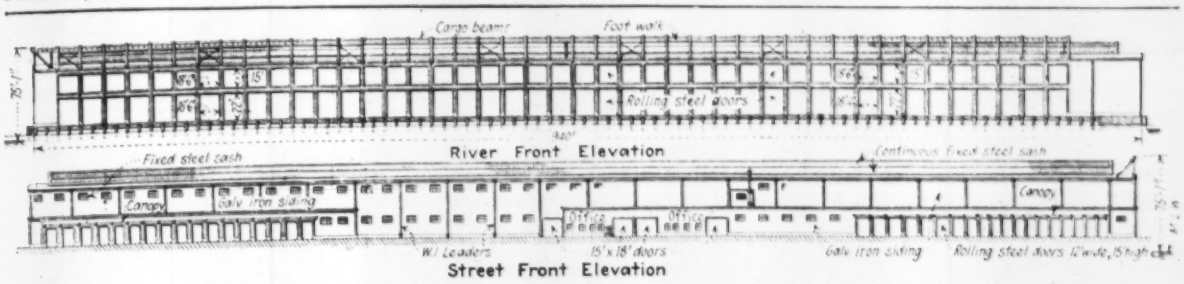


FIG. 2. RIVER FRONT AND STREET FRONT ELEVATIONS—ROLLING STEEL DOORS AND WING APPROACHES

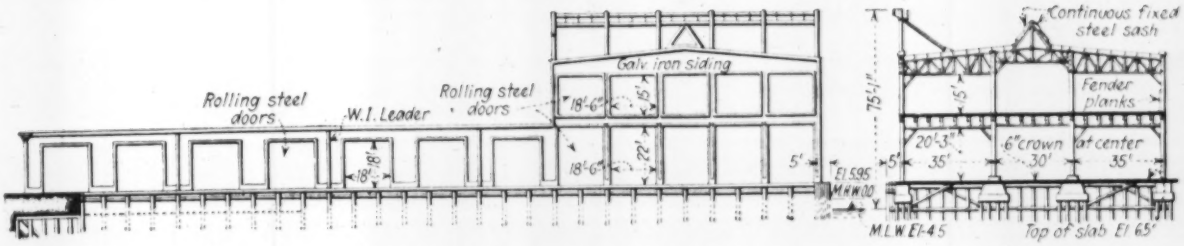


FIG. 3. SOUTH ELEVATION AND SECTION THROUGH TWO-STORY SHED

gage corrugated galvanized iron. Instead of the usual type of monitor with vertical sides a V-shaped skylight is provided at the center of the two-story shed for its entire length with continuous fixed steel sash on both slopes. It is thought that this design gives better and more direct lighting as well as simpler construction. The roof of the two-story shed consists of reinforced-cement tile, 2 x 5 ft. x 1½ in. thick carried on the roof frame. For the one-story shed roof, cement tile 2 ft. wide x 1¾ in. thick x 6 ft. 8 in. to 7 ft. 3 in. long are used.

The floor of the second story is laid with 1¼ in. thick asphalt blocks with the joints grouted, supported on a ½-in. layer of semi-dry sand and cement on a reinforced-concrete slab 4 in. thick. The entire street level floor area within the shed, including wings, is paved in the same way except that the asphalt blocks are 2 in. thick and joints are not grouted. The reinforced-concrete slab is 10 in. thick, supported by a timber pier substructure of piles with 12 x 12-in. cross-caps and 5 x 10-in. low water diagonal bracing. At each column

FIG. 5. WINGS BUILT TO FIT AROUND ROCK BLUFF SERVE AS TRANSIT AREAS

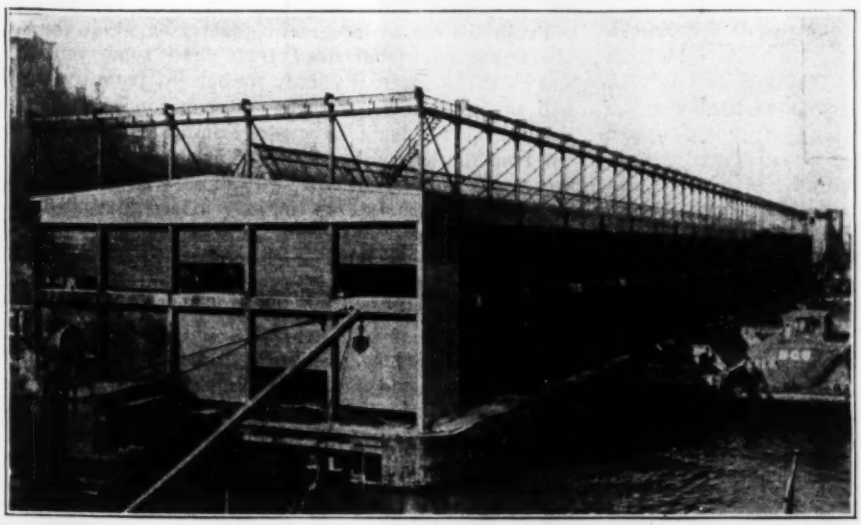


FIG. 4. LONG QUAY FRONT FROM OUTSHORE—PIER-SIDE IN FOREGROUND

base there is a cluster of piles cut off about midway between mean high water and mean low water capped with a block of concrete with base 2.8 ft. below mean high water and 1.7 ft. above mean low water. It is thought that this construction can be considered "permanent" since the small portion of the pile exposed for short periods at low tide will be kept constantly wet.

The quay front looking toward the pier side is reproduced in the photograph, Fig. 4, showing the rolling steel doors on both floors and the swinging cargo beam above the roof. The rolling doors are controlled by

hand chain and are easily operated by one man. The peculiar shape of the wings to fit the roadway running around the base of the rock bluff is shown in the other photograph, Fig. 5. This topography, with a sloping rock ledge running off close to the dredging depth of 35 ft. required at the quay front, necessitated special foundation design to carry the structure for about one-third the length of the front affected by the rock ledge, which came so close to the dredged bottom that piles alone would not hold.

As indicated in Fig. 1, fifteen concrete cylinders were placed at 20-ft. centers along the face of the quay from bent No. 95 to bent No. 67. The construction of the steel cylinder casing and a typical section of bottom conditions encountered are represented in Fig. 6. It was necessary to dredge for 35 ft. depth of water at the quay front with approximate mud line slope of 2 to 1 from shore. Soundings taken by driving piles determined the cross-section of rock ledge and mud at various bent intervals. South of bent No. 67 it was found that the surface of rock was far enough below the bottom to give sufficient holding power to piles. From this point to the north end it was necessary to build foundations on the rock ledge to hold the structure safely.

After dredging in two cuts to approximate the 2 to 1 slope, a steel cylinder was sunk to rock, the cylinder having a removable top section with a 10-in. diameter hole on each side. Mud at the base of the cylinder was then removed with an 8-in. centrifugal pump, the holes in the removable top section admitting water to compensate for pumping out of the cylinder so that the limit of suction lift would not be reached. As soon as soundings with jointed pipe lengths determined the bottom to be reasonably clear a diver was sent down inside the cylinder to finish clearing up and then to place cement bags around the lower side to form a seal to hold the concrete. Before the first concrete was placed in the cylinder by dump buckets the entire bottom as well as that around the circumference of the cylinder was sounded by the construction engineer. Then the cylinder was filled with concrete.

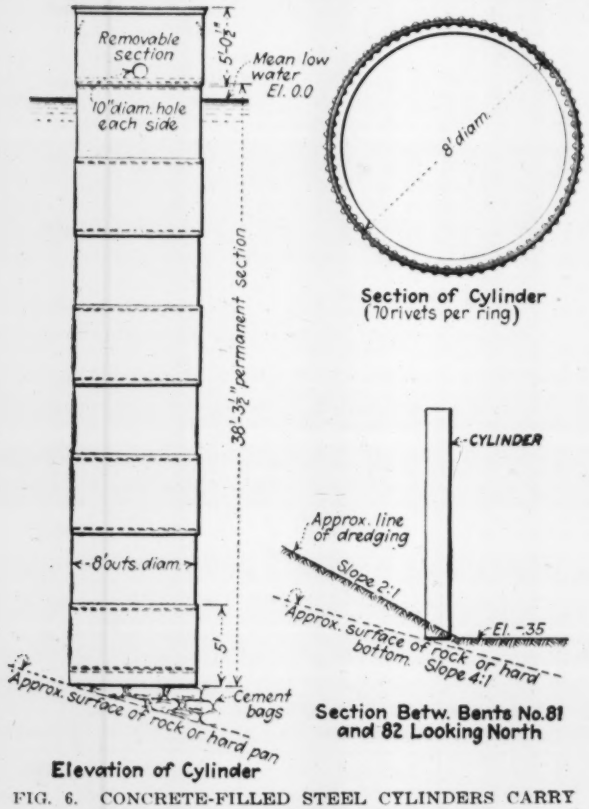


FIG. 6. CONCRETE-FILLED STEEL CYLINDERS CARRY STRUCTURE ON SLOPING ROCK LEDGE

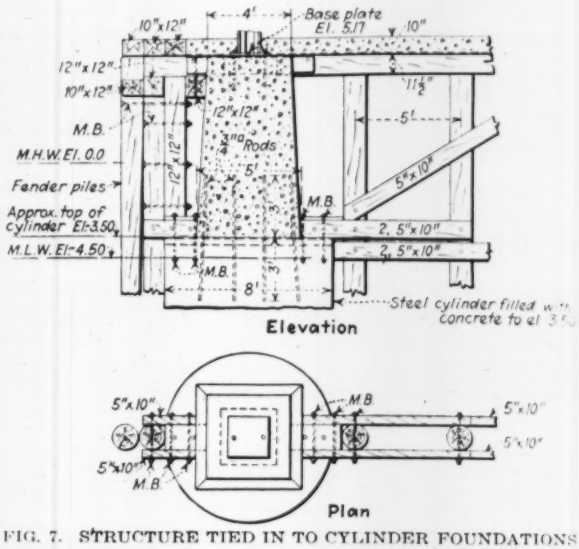


FIG. 7. STRUCTURE TIED IN TO CYLINDER FOUNDATIONS

A pyramid of concrete of 5-ft. base and 4-ft. top surmounts each cylinder as shown in Fig. 7. The structure as a whole is tied in with the cylinders by bolted stringers and diagonals.

The development is now nearing completion and will be put in service immediately. Construction work started in March, 1920. The construction work has been carried out for the Ellerman's Wilson Line by Henry Steers, Inc., contracting engineers, New York City, who also made the design. David Bonner, Jr., was superintendent of construction. J. E. Snell, Newark, N. J., was supervising engineer for the Wilson Line.

Timber Cut from Live and Dead Trees

Prejudice exists in certain quarters against the use of timber cut from dead trees, and some purchase specifications insist that only timber cut from live trees will be acceptable. All the information available at the Forest Products Laboratory indicates that timber cut from insect- or fire-killed trees is as good for any structural purpose as that cut from live trees. If a tree stands on the stump too long after it is killed, the sapwood is likely to become decayed or badly infested by wood-boring insects, and in time the heartwood also will be similarly affected. The same thing is true of logs cut from live trees and not properly cared for. The heartwood of a living tree is entirely dead, and in the sapwood only a comparatively few cells are living. Most of the wood cut from trees is dead, therefore, regardless of whether the tree itself is living or not. Such being the case, all that is essential in purchase specifications, instead of providing that material must not be from dead trees, is to state that material showing evidence of decay or insect infestation exceeding a specified limit will not be accepted.

Freight and Passenger Terminal Problems at Chicago

Steam Railways for Rapid Transit—Freight House Developments—Freight Transfer by Tunnel and Motor Truck

VARIOUS aspects of Chicago's local transportation problems, presented at the spring meeting of the American Society of Mechanical Engineers, held in Chicago on May 23 to 26, included: (1) Intensive and economic use of suburban service on the steam railways; (2) similar use of freight terminals, and (3) the handling of freight to improve the service and relieve the congestion of street traffic.

Steam Railways and Rapid Transit—In the plans for development at railway terminal facilities in Chicago it is unfortunate that no provision is made for rapid transit service. There is no rail communication between the stations, which are thus traffic dumping points instead of distributing points. This was purport of the paper by Bion J. Arnold, consulting engineer, who considers that development of the railways for long-haul rapid transit service can be carried out at a fraction of the enormous expense of providing a new and independent rapid-transit system, such as has been proposed from time to time.

The statement is frequently made by railroad executives, and without refutation, that the commuter rapid-transit business does not pay or is carried at a large loss which must be made up by the long-distance passenger and freight business. There is no better time than the present for the railroads to establish the facts and endeavor to have this traffic handled in a more practicable manner. However, there are some who believe that railroad accounting has not yet been perfected to reveal fully the equitable allotment of terminal and service charges as between long-distance and local rapid-transit service. A careful research into the economics of railroad suburban business should be instituted at once to determine whether the railroads should handle it or should turn it over to some other agency better organized for the purpose.

The steam railroads, which are so strategically located with respect to long-haul suburban commuter traffic, should undertake an immediate reorganization of this great arm of local transportation and co-ordinate its service with the other services of the city in such a way that unified operation of the entire local transportation business may be carried on with the least total expense and maximum usefulness. Local transportation has long ceased to permit of competition as an instrument of regulation, and careful studies of the Chicago situation have shown conclusively the advantages of intimate operating unification, but as a result of misrepresentation of facts the public unwisely opposes this policy.

City Freight Distribution

Steam railways have been driven out of suburban service to a large extent by electric lines, according to E. H. Lee, vice president of the Chicago & Western Indiana R.R. In disagreement with Mr. Arnold, he considered that steam railways utilize their terminals to full advantage and that double-decking their right-of-way for overhead rapid transit lines would not benefit the railways or the public. Existing elevated lines, he said, would not serve the public so well if they had been built over steam railways, as they reach districts not touched by the latter.

Exceptional facilities for the distribution of freight are possessed by Chicago in the underground network of a narrow-gage electric railway system serving numerous railway freight stations and retail and wholesale establishments. The possibilities of this system were reviewed in a paper by J. R. Bibbins, of the National Chamber of Commerce, and E. J. Noonan, engineer of the Chicago Railway Terminal Commission. Although only about 1,800 tons of freight daily are handled at present, the capacity could be increased to 10,000 tons, thus removing a large amount of team and truck traffic from the streets.

Freight movement by motor trucks, including the use of detachable bodies and trailers, was discussed by Hugh E. Young, engineer of the Chicago Plan Commission, who referred particularly to the present tendency toward handling freight by transfer companies under contracts, rather than by the equipment of individual shippers. He mentioned also the proposed marginal thoroughfare on South Water St., which will provide for bypassing much transfer traffic which now passes through the business district and adds to its congestion. (See *Engineering News-Record*, July 22, 1920, p. 173.)

Air Rights and Unit Terminals

Economies promised by the utilization of high-value land in the business section of Chicago by the erection of multiple-story structures were presented by E. J. Noonan, chief engineer of the Chicago Railway Terminal Commission, who dealt particularly with the proposed terminal development outlined in *Engineering News-Record* of May 19, p. 845. Unit operation of various Chicago terminals, introduced under government control during the recent war, was endorsed as a successful move by J. H. Brinkerhoff, general agent of the Northern Pacific Ry., who was terminal manager at Chicago for the United States Railroad Administration. Thus congestion at local freight stations was relieved by sending business to other stations which were not so busy.

Congestions always starts at one point and if prompt measures are not taken it spreads to other lines. Under unified control, measures can be taken to relieve congestion. Under individual operation this has never been accomplished. The handling of a terminal where there is a variety of interests is best accomplished by having it under one head, whose authority should be supreme in deciding questions that arise continually between individual carriers.

This opinion was supported by Mr. Noonan, who suggested that Chicago has an excess of terminal facilities in the business district and a shortage of such facilities on the outside. Unit operation would eliminate many individual agencies, as has been done with success in the stock yards district. Further competition in terminal facilities is not to the interest of the public, he said. In his opinion the railways should give the subject more careful study and consideration than it has yet received.

Drafting-Room Kink

On my drawing board I have a cheap manilla paper about ¼ in. thick which is used for a surface and after changing from a small drawing to a larger one it was very annoying when my pencil would drop into the shell holes made by the Big Bertha thumb tacks, so I now use mucilage. A very little on each corner of the sheet holds it down nicely and to loosen it one corner may be lifted and pulled back. It will leave the corners a little stiff and they will not roll up quite so easily.—F. A. McCurdy, Muncie, Ind.

Construction of Substructure for Platte River Bridge

Concrete Piles Jetted in Sand for New Bridge of C., B. & Q. R.R.—Sand Ejector Clears Concrete Caissons —Steam Box for Rapid Curing of Piles

By J. H. Merriam
Resident Engineer, C., B. & Q. R.R., Lincoln, Neb.

Concrete piers and bents with jetted concrete piles supporting steel girder spans and concrete slab spans having a concrete ballasted deck compose the new bridge over the North Platte River, near Bridgeport, Neb., which was put into service in August, 1920, by the Chicago, Burlington & Quincy R.R. This structure, Fig. 1, replaces a much longer timber trestle built about twenty years ago (new 674 ft., old 1,790 ft. originally, shortened by filling to 1,017 ft.).

A characteristic of the Platte River is shallow water in a wide bed between low banks, with usually two main channels, one near each bank, the middle of the stream having extremely shallow water or low sand bars. The river level has a range of about 6 ft. between extreme high and low water. The bed consists of coarse sand which scours at the rate of about 3 ft. for each foot of rise of the water. Narrowing the river channel is an advantage in that it causes the channels to scour to a greater depth and thus provide openings for the passage of drift and ice during high water. To provide for the above conditions at the Bridgeport bridge, it has been found practicable to deepen the two channels by reducing the width between the banks and placing relatively long spans over the channels, with pier foundations sunk below the line of possible scour.

The new bridge consists of six 60-ft. plate-girder deck spans, three over each channel, with ten 25-ft. reinforced concrete slab spans over the shallow portion of the river between them, and two 16-ft. concrete slab spans at each bank. For the steel spans there are concrete piers supported on concrete piles, while the concrete spans are supported on the caps of double bents built with similar piles. The substructure is built for double track, but only a single-track superstructure has been placed at this time. This is on the upstream ends of the piers and will be the southbound track when the second track is built, the latter being laid on the location of the old trestle.

Preliminary Work.—To permit the use of the old trestle in building the new bridge, a temporary pile trestle to carry the traffic was constructed 20 ft. downstream. It was necessary to alter portions of the old trestle to provide longer spans at the points where piers were to be constructed, each of these long spans being so built as to be removed readily in one piece by a derrick car when work was in progress on the pier below it. Filling 340 ft. of the old south approach required 13,000 cu.yd. of earth, and 15,500 cu.yd. were used to widen both approach fills to provide for the shifting of the main track 14 ft. from the old alignment to the new superstructure. All this material was obtained by widening cuts about four miles north of the river. About two miles of track were required to serve the material storage yard, as the low swampy ground near the river necessitated locating this yard about 3,000 ft. south of the bridge.

Jet Piles—Reinforced-concrete jet piles of the Bignell type are contained in the bents of the concrete spans and in the foundations of the piers of the steel spans; 550 such piles were manufactured at the site. They are 16 x 16 in. in section (Fig. 3) and 40 ft. long, with a 4-in. opening through the entire length, through which water was pumped at pressures varying from 150 to 300 lb. At the lower end this opening is reduced to

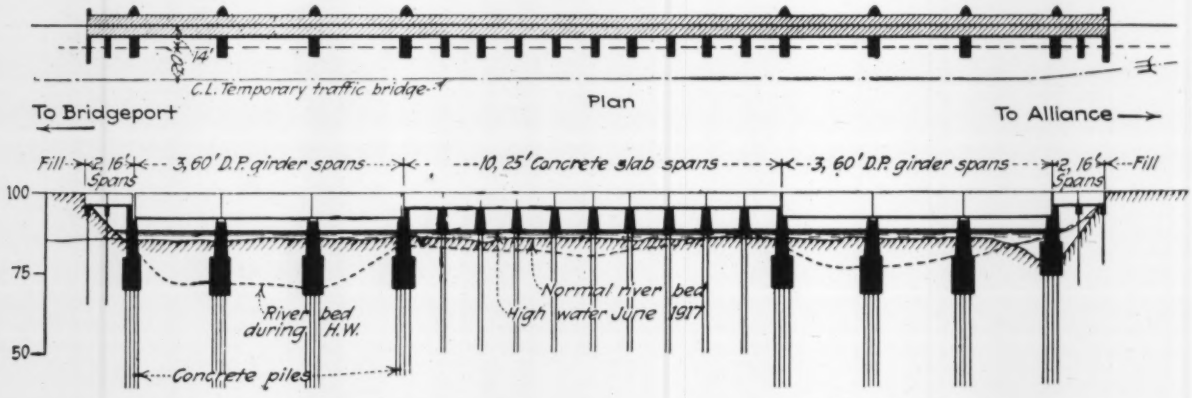


FIG. 1. NEW NORTH PLATTE RIVER BRIDGE; C., B. & Q. R.R., AT BRIDGEPORT, NEB.

1½ in. by a cast-iron nozzle embedded in the concrete, thus forming a jet which bores its way into the sand and clay of the river bed, allowing the pile to sink by its own weight. Lateral pipes extending to each face of the pile are provided at intervals, through which the water is discharged, being diverted upwards by elbows so as to overcome side or skin friction and to wash the displaced material toward the surface. The distance between these laterals is reduced gradually, the first being 10 ft. 2 in. below the head and the sixth being 2 ft. above the point. The piles were handled and sunk with an ordinary bridge derrick car, being slung by the clamp and equalizer outfit shown in Fig. 2.

For the jetting there were two locomotive boilers, one 20 x 8 x 18-in. duplex pump and two 20 x 12 x 10-in. duplex pumps, delivering the water through two 6-in. pipe lines, 400 to 1,000 ft. long. Connection between pipe and pile consisted of two lengths of ordinary

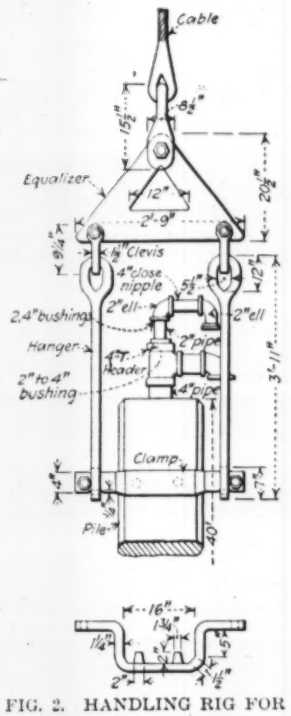


FIG. 2. HANDLING RIG FOR PLACING CONCRETE PILE

2½-in. fire hose coupled to a 4-in. T or header, Fig. 2. The hose was attached while the pile was in a horizontal position. After the pile had been raised with the derrick and spotted for sinking, a connection was made with the pipe line and water was applied. From two to ten minutes were required to sink a pile to its full length of 40 ft. About 70 per cent of the piles were sunk to depths of 52 to 55 ft. These, however, were in cofferdams from which the sand had been excavated to 15 or 20 ft. below the surface of the water.

By means of a special attachment the header was readily disconnected from the driven pile and brought up to be used again. This auxiliary attachment consists of a 36-in. length of 6-in. wrought-iron pipe, split and spread to fit over and around the 4-in. T on top of the pile (Fig. 3), so as to form a socket wrench, which was operated by the stem of smaller pipe extending to the surface, the split pipe being turned so as to unscrew the header.

Pier Caissons—Each of the eight deep piers for girder spans was begun by building a three-pocket reinforced-concrete open box caisson or cofferdam, 12½ x 38 ft., with 15-in. walls 10 to 12 ft. high, Fig. 4. Owing to the shallow water these caissons were constructed in place, with 12 x 12-in. timbers for the shoe or cutting edge, two to five courses being used, depending on the depth of the water. The concrete box was built on top of these timbers and additional 12 x 12-in. timbers were placed on top of the caisson, the latter being removed after the completion of the pier. The boxes were sunk by excavating with a clam shell bucket handled by a derrick car.

As sinking progressed, additional weight was applied by placing concrete piles on top, 160 tons of additional weight being used in some cases. The caisson was kept level by excavating on the high side or end, and also by shifting the additional weight on top as required. Some riprap rock was encountered, and at times this would collect under the cutting edge, where it could not be reached with a clamshell bucket. This difficulty was overcome by the free use of a large water jet which would displace the rock. Small shots of dynamite during the sinking process assisted materially in settling the caissons into final position.

When the cofferdam had reached the proper depth, the concrete piles were sunk to place (45 to 48 piles in each pier). As a clamshell bucket could not be used after these piles were in place, the sand was removed from around the pile heads by means of a home-made hydraulic sand ejector, built up of 3-in. wrought-iron pipe for the discharge and 1¼-in. pipe for the water inlet. These pipes were clamped together side by side, with the 1¼-in. pipe extended a little below the other and returned up into the 3-in. pipe by means of elbows, the returned end being fitted with a nozzle ¾ to 1 in. in diameter. With this device lowered into the sand and water applied at 150 lb. pressure, the sand was readily forced through the 3-in. discharge pipe and delivered outside of the caisson.

After the removal of the sand a 4-ft. sealing course of concrete was placed through the water by means of a tremie. After allowing this concrete to set for about 24 hours, the cofferdam or box was unwatered, the top of the sealing course cleaned, and the base of the pier concreted in the dry to its proper elevation. Neat work forms were placed and the pier completed, as shown in one of the details in Fig. 5.

Double pile bents of twenty piles each (ten for each track) are used under the 25-ft. slab spans, as also

FIG. 3. CONCRETE JET PILE AND DETAILS OF HANDLING RIG

shown in Fig. 5. These piles were sunk to depths of 36 ft. The tops, projecting about 4 ft. above the water, were capped with concrete and finished to the proper elevation. The heads of the piles in the two rows are connected by stirrups embedded in the caps. Each of the approach bents consisted of twelve concrete piles in lengths of 18, 26 and 30 ft.

Concrete Work—Precast slabs were used for the four 16-ft. end spans, these being made at the bridge site and placed by derricks. The ten 25-ft. concrete slab spans were built in place, using falsework of two 3-pile bents for each span to support the forms. Each of the

steel girder spans was handled and placed on the new piers as one unit, its weight being about 30 tons. Precast concrete deck slabs were then placed on the girders, and the bridge was completed with ballast and track.

The concrete plant for the bridge work was operated also for the purpose of manufacturing concrete piles and slab spans of various lengths for general use on the northwest lines of the Burlington System. During 1919 and 1920 the following products were manufactured and shipped from this plant: 34,000 lin.ft. of 14½ x 14½-in. solid concrete piling; 482 reinforced-concrete slabs, 7 x 14 ft. to 7 x 20 ft., and 1,833 concrete blocks 36 x 36 x 4 in. These were all made in connection with the bridge work, using the same force and equipment. Concrete work was carried on throughout the winter months, using heated materials and warm water. Finished work was protected by covering with tarpaulins and heating with steam. A portable concrete plant was used for the entire work. It consisted of a 10-ft. drum mixer mounted on a flat car, steam being furnished by a small vertical boiler mounted on the car. Gravel and cement were handled from cars adjoining. This outfit was readily moved from place to place as required. The mixer discharged at the end of the car, permitting the concrete to be spouted to either side of the track. A light locomotive assigned to the job did all the switching and handling of equipment and loads. Two derrick cars of about 25 and 30 tons' capacity were in use most of the time, only one of these being self-propelling.

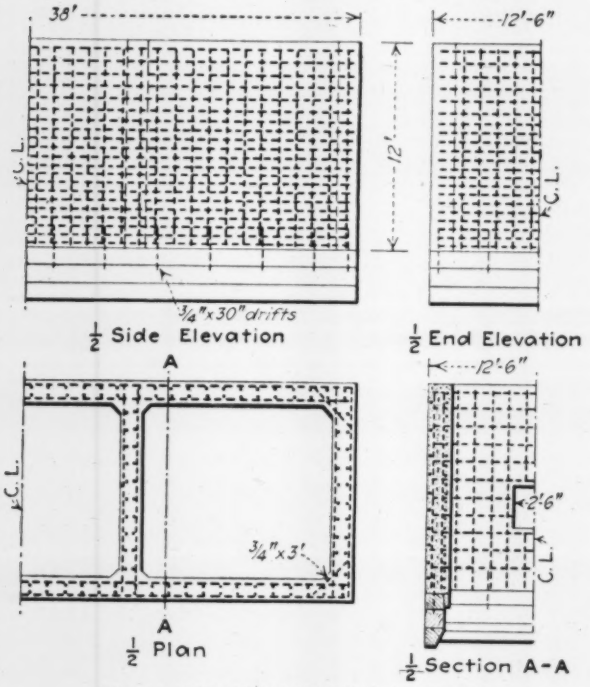


FIG. 4. CONCRETE CAISSON FOR PIER

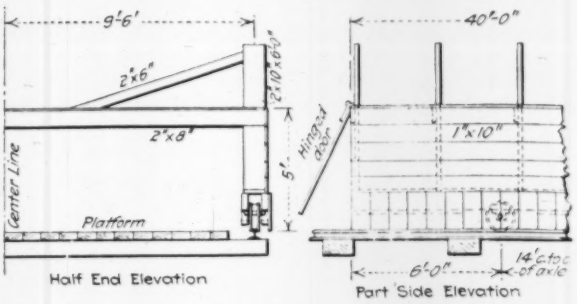


FIG. 6. STEAM BOX FOR CURING CONCRETE PILES

Steam Curing—Steam boxes, or drying houses fitted with steam pipes, were used in curing the concrete piles and other products, which were cast in forms laid on a platform 20 x 300 ft., constructed of timbers embedded in the ground. These steam boxes spanned the platforms and were operated by hand on a track of 19-ft. gage, being placed over the freshly-poured concrete products. By this means it was possible to remove piles from the forms in 14 to 16 hours after being concreted, enabling the forms to be released for use. The piles were picked up in a horizontal position, loaded on flat cars and unloaded in a storage yard where they were permitted to cure for thirty days before being shipped.

The steam boxes, Fig. 6, were designed and used for the purpose of expediting the process of curing and thus reducing the number of forms and the platform space required, as well as to permit concreting to be done in cold weather. They were of light timber construction, each being about 19 x 40 ft. and 5 ft. high, with ends hinged at the top so that they could be swung out and up when moving the box over the forms. Each box was mounted on six or eight double-flanged wheels.

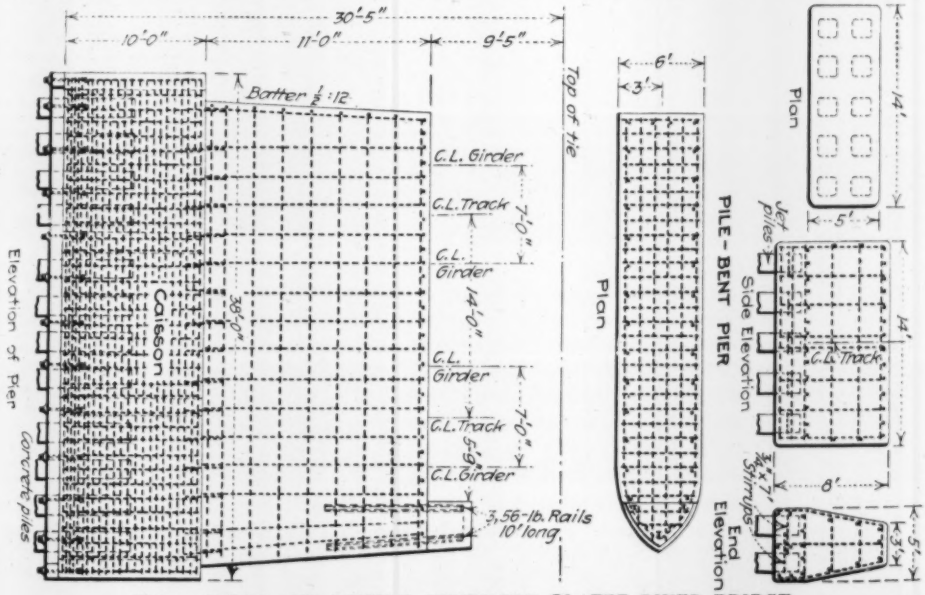


FIG. 5 PIERS AND DOUBLE BENTS FOR PLATTE RIVER BRIDGE

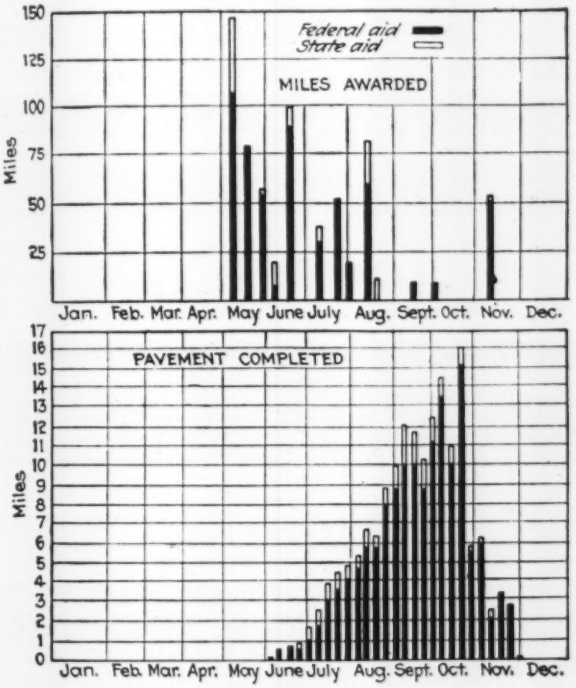
when the box was in place over the freshly-filled forms the ends were lowered and fastened and steam at low pressure was applied through 1¼-in. pipes suspended from the roof and sides of the box. Three of these boxes were used on the work.

Construction work was begun in August, 1918, and the bridge was put in operation on Aug. 18, 1920. All work was done by company forces under the supervision of A. W. Newton, chief engineer Chicago, Burlington & Quincy R.R.; G. A. Haggander, bridge engineer, and F. T. Darrow, assistant chief engineer. The writer was resident engineer.

Contract Dates and Peak Outputs

By B. H. Piepmeier
Engineer of Construction, Springfield, Ill.

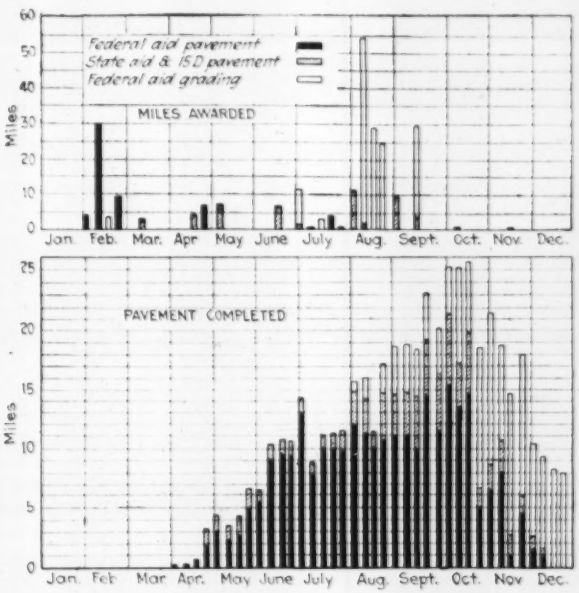
AN EXAMINATION of two years' work in constructing paved roads in Illinois clearly shows the advantage of letting contracts early in the season. During 1919 approximately 504 miles were awarded in April, May, June and July, the peak of awarded mileage being in May. The progress chart for 1919 shows that the contractors did not reach their peak of miles completed per week until October, some five months later. It takes a contractor 60 days to organize and get ready to lay



HIGHWAY CONSTRUCTION AWARDED AND COMPLETED IN 1919

pavement and from 30 to 50 days to reach his maximum output after he starts construction.

The 1920 chart shows that the peak mileage constructed for any one week was reached the week ending Oct. 1. However, a very large weekly mileage was reached in June and was practically maintained for a period of four months, when construction suddenly slumped on account of winter. A good record was made in June on account of the large mileage of work brought forward from 1919. In the spring of 1920 many of the contractors had equipment on their jobs and were ready to start construction as soon as weather conditions permitted and they could organize their forces.



HIGHWAY CONSTRUCTION IN 1920

The chart indicates a large mileage of earthwork awarded during the late summer months of 1920. The peak of grading work was reached the week ending Nov. 4, a comparatively short period after the peak of awards. On grading work a contractor can reach his maximum of yardage moved per day within 30 days after receiving his contract, while on pavement construction he must count on at least 90 days.

On account of unfavorable conditions that existed throughout 1920, no exceptional records were made or no one method of handling work proved to be worthy of special mention or recommendation; however, general statistics of the work are of interest: (1) The largest number of days a concrete paver was operated on a single job was 131. The largest output with one mixer was 86,592 sq.yd., or 8.2 miles of 18-ft. pavement. This record was made in 107 working days, using trucks to deliver materials direct to the paving mixer. (2) The largest number of square yards laid under the supervision of one contractor was 260,000, or 27.45 miles. (3) The largest daily output with one mixer was 1,694 sq.yd., or 847 ft. of 18-ft. pavement. On this job an eight-bag paver and an industrial railroad for transportation of materials were used. The largest week's as well as the largest month's record (0.72 miles and 2.44 miles, respectively) were made by a contractor using a four-bag paver with industrial railroad delivery of materials.

A further analysis of all jobs shows that industrial railroad equipment was used on 44 jobs, and the averages were 1,940 ft. per week and 5,264 ft. per month. Central mixing plants, with truck delivery of mixed concrete, were used on 12 jobs, and the averages were 1,495 ft. per week and 4,272 ft. per month. For batch boxes on trucks delivering materials direct to the paving mixer, there were 11 jobs and the averages were 1,331 ft. per week and 2,589 ft. per month. There were four jobs with material dumped on subgrade and a belt conveyor to the mixers, and the averages were 1,022 ft. per week and 5,563 ft. per month. On 48 jobs with materials dumped on subgrade and shoveled or wheeled to a paving mixer, the averages were 1,462 ft. per week and 3,117 ft. per month.

Notes on California Rock Tunneling Practice

Tunnel Sizes and Methods of Driving, Recent Improvement in Equipment for Drilling and Mucking, Electric Exploders, Terms of Tunnel Contracts

By A. J. Cleary
Consulting Engineer, Construction Company of North America, San Francisco

HYDRO-ELECTRIC development has received a very strong impetus since the war. Most of the hydro-electric projects in the West include considerable tunnel construction and, in many instances, the tunnels are controlling time factors, governing the date on which the projects can be completed and a revenue obtained. Under these conditions it is natural that speed and economy in tunnel work have recently been given very careful study by construction engineers, particularly in California, and some notable achievements have been recorded. The trend of rocktunneling practice in some of the factors that have a direct bearing on these developments is discussed in the following notes:

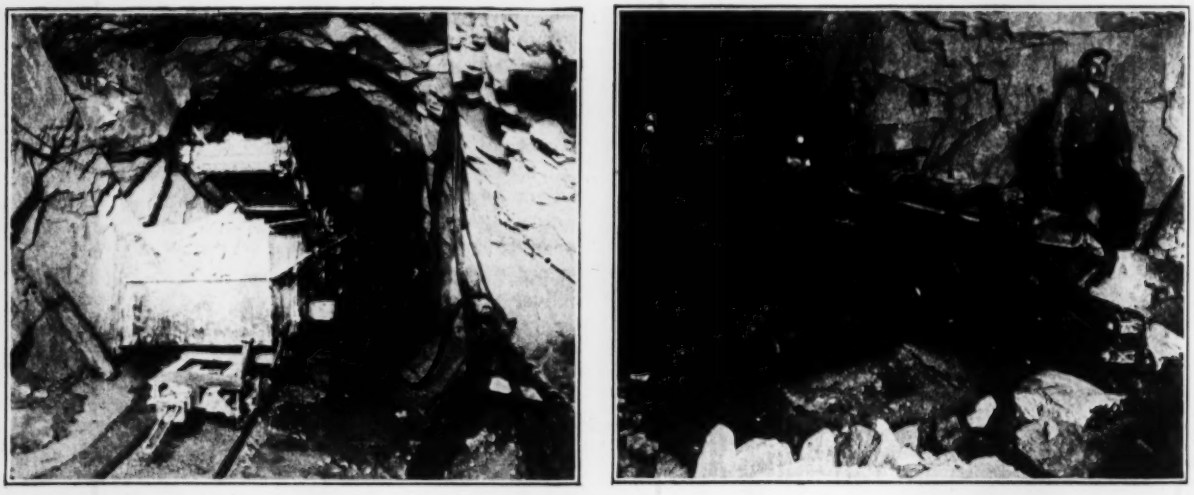
Intermediate Headings—In the survey for a long aqueduct tunnel it is frequently economical to lengthen the alignment in order to secure suitable adit or shaft sites, in order that the distance between headings may be reduced.

On a tunnel of considerable length, after the final location survey has been completed, it has been found advisable, if a close estimate of the cost is required, that a series of diamond drill borings be made along the tunnel line. These drill holes should be put down from the surface to intersect the tunnel grade at intervals sufficiently close to enable a competent geologist, after a field study, to plot with a reasonable degree of accuracy the formations through which the tunnel will pass. Not only can the geological formation be thus determined, but some idea can be obtained as to the location and extent of water-bearing strata. These are important factors in the cost of the tunnel.

Methods of Attack—In tunnels under 16 ft. in width and height, three methods of breaking ground are in common use: (1) The top-heading-and-bench plan, (2) shooting the full face in one operation, and (3) undercutting and trapping. In a long tunnel it may be advisable to try out for a short period all three operations and adopt that which proves cheapest. In most tunnels under 14 ft. in width and height, working the full face has a number of definite advantages over either the heading-and-bench plan or undercutting: It is possible to get in a more effective round of cut holes and pull longer rounds; time and labor are saved over mucking back a heading by hand preparatory to setting up drill columns; the entire round can be mucked by machine; by using a staging, drilling and machine mucking can be done at the same time.

Drill Steel—The manufacture of drill steel has been brought to a high degree of perfection abroad in recent years. On the Hetch Hetchy project tests were made on practically every brand submitted by American and foreign manufacturers. It was found that for the particular type of rock traversed by the 18-mile Hetch Hetchy aqueduct tunnel, Viking brand Swedish steel stood up best and was most economical. The experiments were made in 1919 and 1920, and as a consequence, Swedish steel has been used continuously on the Hetch Hetchy work ever since. There is no reason, however, to predict that this condition should continue, as American manufacturers are now giving more study to the subject of producing a more efficient and economical drill steel, realizing the importance of manufacturing a better product than has heretofore been produced.

Drill Forges—Oil furnaces are used extensively in the blacksmith shops of modern tunnel camps in connection with drill sharpening, shanking and welding, and are much to be preferred over coal forges. They are more economical in time and cost, provide a more

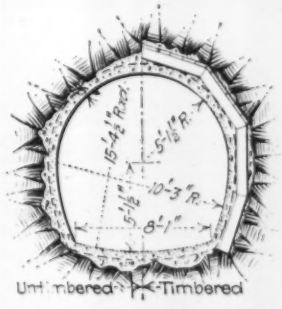


MYERS-WHALEY AND SHUVELODER MUCKING MACHINES IN SMALL-SECTION TUNNEL

uniform heat, are cleaner, and take up less floor space. There are several types and sizes of oil furnaces manufactured. Where one sharpener is in operation a No. 3 Ingersoll-Rand furnace or its equal gives good results. The cost of operating a No. 3 oil furnace with fuel oil at 7.5c. per gallon is $1.11 per 8-hour shift. For a coal forge with coal at $40 per ton the corresponding cost is $1.80.

Various experiments have been made with removable bits for drill steel, the theory of the inventors being that these would save the cost of drill sharpening, since they could be manufactured at a very low cost and thrown away when dulled. To date none have come within the writer's knowledge that gave efficient or satisfactory results.

Heading Machine—Another device, for which much was claimed by its manufacturers, but which did not succeed on the hard rock encountered on the Hetch Hetchy tunnels, was the Karns "heading machine." This was in effect a large piston drill pneumatically operated, designed to drill a central hole 12 in. in diameter. This hole, which was not loaded, was intended to take the place of the ordinary center cut, affording a free space to which the material could break when the other holes, drilled with ordinary 1⅛-in. drills, were shot. The device worked fairly satisfactorily for a few days, but could not stand up under continuous use.



HETCH HETCHY TUNNEL SECTION

Drilling Layout—Considerable study has been given of late to determining the most effective positions and directions of the drill holes. This will vary with different formations, with the size of tunnel and the length of the round to be pulled. When the proper angle for the cut holes has been determined in a particular instance, templets are frequently used for the direction of the drills so that there may be no variation or misplaced holes.

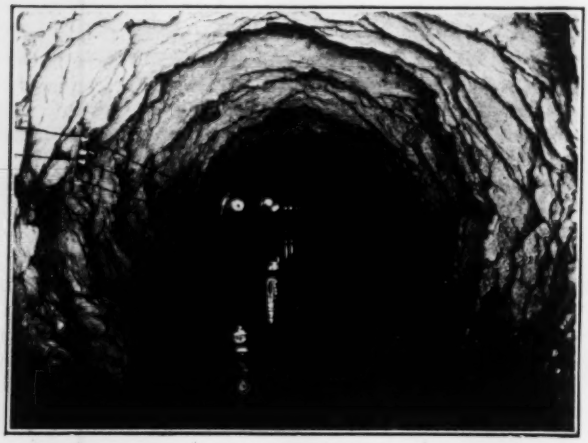
Drill Carriages—Where progress is not so essential as to be given preference over economy, a drill carriage with the requisite number of drills mounted and ready for operation is sometimes used. Since drilling and mucking cannot be carried on simultaneously by this method, its use means a slowing up of progress; this does not cause as much delay as might at first appear, however, particularly where the headings are being driven from the same adit or shaft. In such cases drilling is carried on in one while mucking is done in the other, and vice versa. With a drill carriage and a full tunnel face, the holes can be pointed with absolute accuracy. No time is lost setting up drills. Steel and tools are at hand, with no loss of wrenches, etc., in the muck pile; and only short lengths of air and water hose are necessary. The use of such a carriage also facilitates loading. When drilling is completed, the entire carriage is brought out of the tunnel and all drills are gone over and made ready for the next round. Moreover, where motor-driven mucking machines are used, a drill carriage makes possible a large saving in power since the compressors can be shut down when the drilling is finished.

Firing—A separate firing circuit is generally used with electric delay exploders. It terminates at a safety firing switch, which may be kept about 1,200 ft. from the heading. Ordinarily 440 volts are used, a strong current lessening the liability of misses due to poor connections. The California Cap Co. now manufactures a special-interval delay-action exploder which allows more than double the standard interval between delays. With delay-action exploders a round of holes can be more accurately timed than with fuse and cap, the possibility of missed holes from water and cutoffs lessened, and the noxious smoke from burning fuse eliminated.

In electric blasting a simple expedient has been adopted to make sure that there will be no missed holes. The terminal wires on the delay-action exploders are wrapped with different colored cord and connected in parallel to bus wires. By this simple means, when all holes are loaded and ready to shoot, the shift boss can simply count the number of like colored terminals attached to the positive bus wire and the number of a different color attached to the negative. These must check up with the number of holes to be exploded. This prevents attaching the two terminals of the same exploder to the same bus wire, which would result in a missed shot. A yellow and a black wire are most easily distinguished in the dim light of a tunnel.

Power Mucking—Heretofore the removal of muck has been the most tedious and costly part of tunnel driving. In fact, mucking was considered such a serious factor, in comparison with drilling and shooting, that not more than two years ago on an important hydro-electric development in California the dimensions of the tunnel were increased so that the effective area was almost doubled in order that air shovels could be used in the tunnel to handle the muck. The fourth edition of the American Civil Engineers' handbook, published in 1920, states, "Many mechanical muckers have been devised, but none have come into general use except the small steam shovel operated by compressed air." Since the above statement was published it is conservative to state that mechanical muckers have come into general use for small tunnels. In California there are in use today at least 12 Myers-Whaley mucking machines and 20 "Shuveloder" machines. Both of these types have effected a considerable saving over hand loading. They can handle from 6 to 10 cu.yd. per hour, and aside from the saving in cost of mucking, tend to reduce the labor turnover.

To obtain the best results it is essential to keep a siding for empty muck cars as close to the heading as possible, and have ample car and haulage capacity so that the machines can work continuously in handling each round. Portable sidings are essential and should be kept within 200 ft. of the face to save time in switching. The Shuveloder is operated by compressed air and moved around by hand, while the Myers-Whaley mucker is operated and moved electrically. A study of local conditions is necessary to determine which machine is best adapted and most economical for a particular job. The Myers-Whaley has fewer breakdowns; the Shuveloder is cheaper in first cost. Other mucking machines, among which the Hoar shovel may be mentioned, have been used with satisfactory results. On at least one Pacific Coast tunnel job the Hoar machine is now being tried out in competition with the Myers-Whaley and the Shuveloder.



SOUTH FORK TUNNEL, HETCH HETCHY

The principal defect of mucking machines is the frequency with which break-downs are apt to occur. The manufacturer who improves his shovel so as to most nearly eliminate this defect will have the best opportunity to get future business in this line.

Where speed of construction is an important factor, it is now necessary to provide two machines for each heading in order that a reserve machine may be ready for service when break-downs occur. Even with the additional first cost necessitated by such procedure, the saving in time and delays from the disruption of the working forces justifies the additional expense in first cost, and is good economy.

Haulage—The cost of hauling muck from the heading to the dump has been decreased by the use of electric or gasoline motors. In California the law prohibits the use of "fuel-burning locomotives except in tunnels open throughout their length," because of the poisonous fumes released by the exhaust from gasoline motors, which may prove dangerous except in exceedingly well-ventilated tunnels. Electric motors are therefore used exclusively in California for tunnel construction operations.

The advantage of storage battery over trolley motors for use in tunnels of small diameter is the elimination of exposed high-voltage trolley wire with its incident hazards in close quarters. An efficient storage battery locomotive for a long tunnel should have a minimum drawbar pull of 1,200 lb. and be able to handle 50-ton trains at 4 mi. per hr. against a 0.15 per cent grade.

Such locomotives are manufactured by the principal large electrical companies. Storage battery equipment which has been found satisfactory consists of 80 cells of Edison A-6 batteries and two H.M. 828 GE ball-bearing motors or their equal. Such a locomotive can pull 50 tons 12 miles up a 0.15 per cent grade without recharging.

A motor-generator set with a capacity of 15-kw., consisting of a three-phase 440-volt motor direct-connected to a 150-volt d.c. generator, fully recharges a discharged locomotive in 7 hours. As the load hauled toward the heading consists generally of nearly empty cars, requiring a correspondingly smaller expenditure of current, an average distance that a battery locomotive can negotiate every day in the year would be from 40 to 50 miles. This includes allowance for time required for recharging.

Lining—Hard-rock tunnel aqueducts are frequently lined with concrete, for the sole purpose of increasing their capacity by reducing friction. Where the formation warrants, it is generally more economical to obtain this greater capacity by using a larger unlined section. In many formations, however, lining is absolutely essential, particularly for pressure tunnels. The pneumatic method of mixing and placing concrete is fast superseding hand placing on long tunnels. At least two successful pneumatic mixers are now on the market. One company has recently developed a portable mixer which is shifted along with the forms. This minimizes the expense of discharge pipe and also the amount of air necessary to mix and place each batch.

A machine recently developed on the Pacific Coast for placing concrete tunnel lining, known as the Webb & Cox universal concrete gun, has gained rapidly in popularity after making good records on a few jobs.

LARGE-SECTION TUNNEL (KERCKHOFF), MUCKED BY AIR SHOVEL

It consists essentially of a cylinder into which a batch of mixed concrete is dumped and from which the concrete is forced into the delivery line by a piston actuated by compressed air. This puts a positive thrust behind the charge and gets it into the delivery line in a compact mass, after which delivery to the forms is effected by air pressure in the usual way. The gun is used for short-distance delivery only, the concrete being taken into the tunnel to it in dump cars. It effects a considerable saving over the amount of air used in the ordinary pneumatic process. As used in the recently completed tunnel on the Caribou project, this gun placed an average of 10 cu.yd. of concrete per hour.

To keep pace with the increased speed of mixing and placing concrete which pneumatic delivery systems have introduced, important developments have been made in the traveling steel form. Speed in collapsing, moving forward and re-setting is their chief advantage over the forms that have to be taken down to be moved.

Cost-Plus Contracts—In tunnel work, as in most construction operations of great magnitude where unforeseen hazards may greatly affect prices, the plan of contracting for cost-plus-fixed-fee with maximum cost guaranteed is now often preferred to the flat unit-price plan. The forfeit in case the guarantee is not met may include any portion or all of the fixed fee, or any part of or the entire amount by which the guaranteed price may be exceeded. A percentage of the saving effected

by performing the work lower than the guaranteed cost is often included in the contractor's compensation. The advantages of such contracts are mutual.

How the cost-plus-fixed-fee contract reduces the cost of the work is shown in the accompanying table of itemized bids on 18 miles of Hetch Hetchy tunnel. The prices given are averages of bids made in April, 1920.

ITEMIZED BIDS ON UNIT PRICE AND COST-PLUS-FIXED-FEE, HETCH HETCHY TUNNEL

Item No.	Item	Quantity Estimated	Unit	Unit-Price Bid — Items	Unit-Price Bid — Totals	Cost-Plus-Fixed-Fee Bid — Items	Cost-Plus-Fixed-Fee Bid — Totals
1	Lined tunnel between Early Intake and South Fork	16,400	Lin.ft.	$107 00	$1,754,800	$78 95	$1,294,780 00
2	Lined tunnel between South Fork and Adit No. 8-9	24,744	Lin.ft.	105 00	2,598,120	84 20	2,083,444 80
3	Lined tunnel between Adit No. 8-9 and Priest Portal	41,600	Lin.ft.	109 00	4,534,400	82 08	3,414,528 00
4	Extra price for permanently timbered tunnel	10,000	Lin.ft.	10 00	100,000	25 00	250,000 00
5	Concrete lining in tunnels excavated by the City	24,000	Cu.yds.	20 00	480,000	16 50	396,000 00
6	Concrete lining in shafts excavated by the City	2,700	Cu.yds.	22 00	59,400	20 00	54,000 00
7	Construction Shaft No. 2, with lining, below the part excavated by the City	425	Lin.ft.	400 00	170,000	330 00	140,250 00
8	Additional excavation in tunnel and shaft	5,000	Cu.yds.	10 00	50,000	10 50	52,500 00
9	Additional concrete in tunnel and shaft	5,000	Cu.yds.	20 00	100,000	15 00	75,000 00
10	Extending Adits	100	Lin.ft.	40 00	4,000	45 00	4,500 00
11	Excavation in open cut	500	Cu.yds.	8 00	4,000	2 50	1,250 00
12	Concrete in open cut	500	Cu.yds.	20 00	10,000	15 00	7,500 00
13	Extra cement	5,000	Bbls.	6 50	32,500	5 00	25,000 00
14	Furnishing and placing reinforced steel	40,000	Lbs.	10	4,000	10	4,000 00
15	Placing reinforcing steel furnished by the City	10,000	Lbs.	05	500	02	200 00
	Total cost				$9,901,720		$7,802,952 80
	Alternative for part to be enlarged, unlined section (average)			$91 00		$67 35	

Five miles of the Hetch Hetchy tunnel have now been bored and the present cost is very close to the contractors' guarantee. With recent decreases in the cost of labor and materials, it is believed that a considerable saving below the contractors' guaranteed price will be effected. The Hetch Hetchy work is being carried on under the direction of M. M. O'Shaughnessy, city engineer of San Francisco, by the Construction Company of North America.

Washington's Town Plan for Alexandria

THE original manuscript plans made by George Washington in 1748 and 1749 for the town (now city) of Alexandria, Va., have been acquired by the Library of Congress. The following statements regarding the maps is taken from the Report of the Librarian of Congress for 1919-20:

The library is fortunate in having secured the manuscript plans by George Washington, of the city of Alexandria, Va. As there is no mention made of this work in any notice of Washington's writings, a full description may be of interest: "Plat of the Land where on Stands the Town of Alexandria. By a scale of 15 Po to ye Inch. 12¼ x 15½. (1748) A Plan of Alexandria now Belhaven 12⅜ x 15⅜. (1749)."

Alexandria is located on land which formed part of a large grant to Robert Howsen in 1669. Howsen sold his land to John Alexander in 1677.

In 1730 a public tobacco warehouse was established on this tract, and the hamlet which grew up about it was called Belhaven, and was known by that name until the town was laid off under an act of the General Assembly of the Colony of Virginia, which was passed in 1748. This act authorized the survey and laying out of a town at "Hunting Creek Warehouse on Potomac River," the town to cover 60 acres of land "parcel of the lands of Philip Alexander, John Alexander, and Hugh West," and "that the said town shall be called by the name of Alexandria."

The trustees appointed for the town included Lord Fairfax, William Fairfax, George Fairfax, Richard Osborne, Lawrence Washington, William Ramsey, John Carlyle, John Pagan, Gerard Alexander, Hugh West, and Philip Alexander. The surveys having been made in accordance with the charter, the first meeting of the trustees was held on July 13, 1749. On the two days following, the town lots were sold at auction under the supervision of the trustees, and at the next meeting of the trustees, on Sept. 20, deeds for these lots were executed.

Of these two maps of Alexandria drawn by George Washington the earliest is the "Plat of the Land where on Stands the Town of Alexandria," the title being noted on the reverse of the map, probably at some later date.

It is an outline of the area to be covered by the town which is here marked, "Area 51 acres 3 Roods 31 Perch." At the upper end of the area buildings are indicated and marked "Mr. Hugh West Ho. & Ware Hoss." The road upon which these buildings are indicated extends from "Ware Ho. Point" through the area and is marked. "Road round Hd of the Crk. &c." Beyond the road is "A fine improvable Marsh."

Along the water front the river is marked: "The Shoals or Flats about 7 feet at High Water." and a line farther out in the river reads, "The Edge of the Channell of the River. 8 Fathoms." The following note appears at the foot of the map: "Note that in the Bank fine Cellars may be cut from whence wharfs may be extended on the Flats witht any difficulty & ware Housses built thereon as in Philadelphia & C. Good Water is got by sinkg wells at a sma.l depth. The above area of 51 Acres 3 Rd. 31 Perch belongs to Capt. Phill. Alexander, Capt. John Alexander, Mr. Hugh West."

This map was evidently made in 1748, when Washington was 17 years old, after his return from his surveying expedition on the lands of Lord Fairfax in the Northern Neck of Virginia, 1747-48, and subsequent to the act by the General Assembly.

In Washington's Journal of 1747-48 the only reference he makes to a survey of Alexandria follows a place where several pages are torn out. The reference reads:

The Courses of the Town of Alexandria
The Meanders of the River
S 84 ½ Et 3 Chain
S 52 Et 4 C 17 L
S 24 E 5 C 9 L to the Point at the sm. Hickory stump above the Landing Place
S 70 E 1 C 25 L
S 45 E 3 C 18 L

The other map, "A plan of Alexandria now Belhaven," was evidently made prior to the organization of the municipal government at the first meeting of the trustees, on July 13, 1749.

Engineering Studies for Philadelphia-Camden Bridge

Location Fixed by Traffic, Street Conditions and Cost—Rock at 100 Feet Depth—Single-Span Superstructure With 135-Foot Clearance Height—Suspension Bridge Cheaper Than Cantilever

WHEN New Jersey and Pennsylvania and the city of Philadelphia agreed to construct jointly a highway bridge across the Delaware connecting Philadelphia and Camden, about a year ago, the location and type of bridge had not been decided upon, the foundation conditions were not known, and only very rough estimates of the probable cost of the enterprise were available. The joint commissions charged with the work therefore referred these subjects to a board of engineers for study. Since the appointment of this board last October its investigation has been in progress, covering studies of traffic, of the conditions governing river clearance, of subsoil and depth to rock, and of the relative costs of different types of structure. The board reported on June 9, as noted in our issue on June 16, p. 1049. The details of its analysis of the problem as well as its results have important bearing on large bridge planning. A summary of the essential points is therefore given in the following:

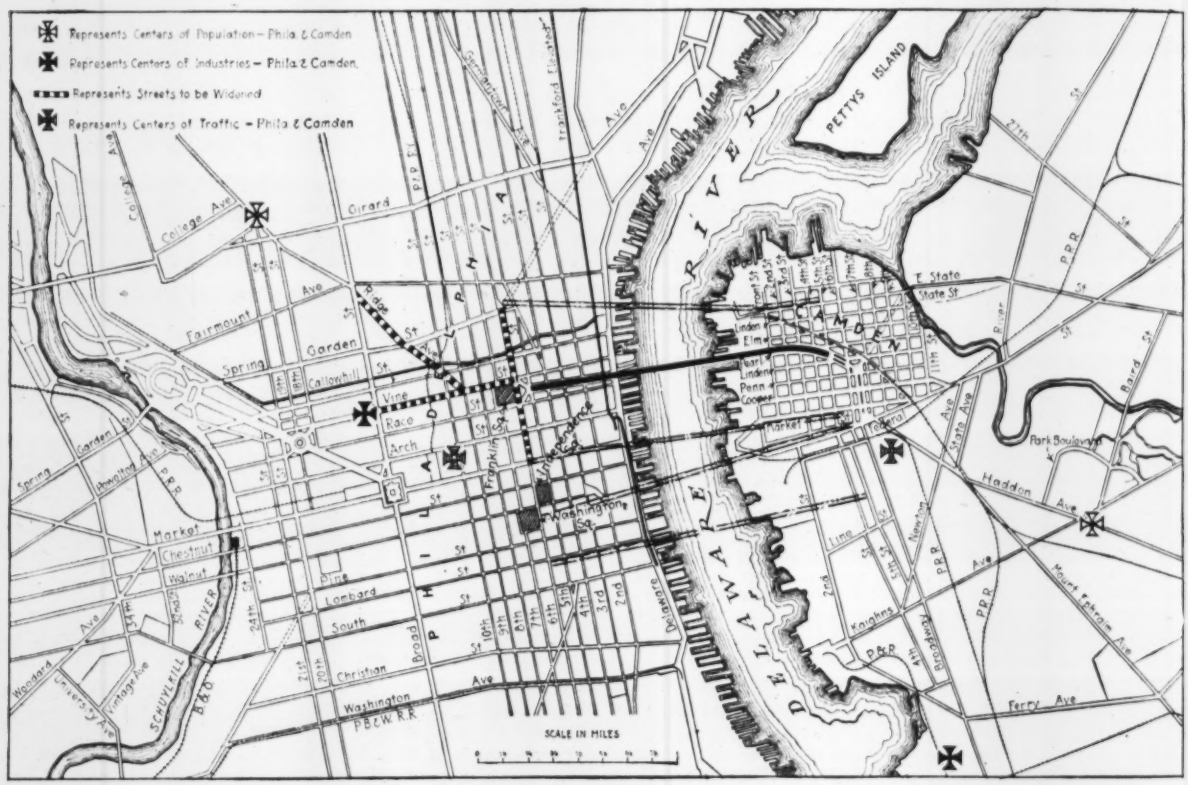


FIG. 1. DELAWARE RIVER BRIDGE LOCATION WITH RESPECT TO MAIN STREETS AND CITY FOCAL POINTS

Earlier studies of the project had been made by J. A. L. Waddell and by W. P. Laird. Dr. Waddell four years ago reported that a bridge would be preferable to a tunnel, and prepared a suspension bridge design with helical incline approaches. A short time later Prof. Laird made a study of the most desirable location of a high-level bridge, with the result of recommending a location terminating at Washington Square, in the neighborhood of Sixth and Locust Sts., Philadelphia. The board also had before it proposals by various parties for other crossing sites, ranging over a two-mile length of the river from Lombard to Spring Garden St., each with active partisans. The instructions to the board on the matter of location were that the three best sites in the range between South and Green Sts. should be compared and the most desirable one recommended for adoption.

As indicated by the sketch map, the Delaware River at Philadelphia is of substantially uniform width and almost straight, with pierhead lines 1,700 to 1,800 ft. apart. The water depth is about 50 ft. Shipping past Philadelphia is of small volume. On the Camden side a sharp bend not far north of the line of Spring Garden St. limits favorable locations. The shore on the Camden side is quite flat, while on the Philadelphia side it slopes up somewhat. As the Philadelphia streets are generally quite narrow, special importance attaches to minimum interference of bridge approaches with thoroughfares, and efficient distribution of traffic at the terminals.

Factors Determining the Location—Five locations were studied by the board, as indicated on the map. Each was considered with respect to the practicability of developing suitable approaches; adaptation to local obstacles such as railway terminals and yards; the amount, origin, and destination of the present cross-river traffic; the relation of the bridge to future through traffic; and foundation conditions as disclosed by core borings. At the same time the matter of navigation

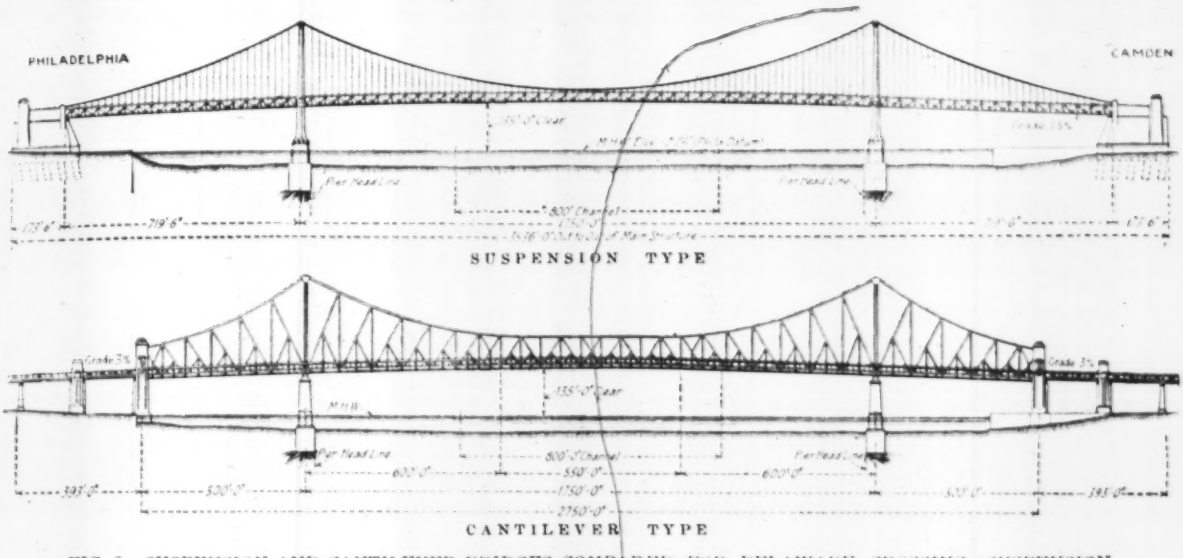


FIG. 2. SUSPENSION AND CANTILEVER BRIDGES COMPARED FOR DELAWARE CROSSING—SUSPENSION TYPE FOUND CHEAPER

clearance height was taken up with the War Department through the local engineer officer, Major L. E. Lyon.

Borings showed the underlying rock to be Wissahickon gneiss, overlaid by disintegrated rock 5 to 35 ft. deep. At the west and east banks at the three main sites the first core samples were recovered at the following depths: Spring Garden, 69.5, 111.4; Franklin Square, 86.7, 91.6; Washington Square, 111.8, 104.5.

Traffic Studies—Present ferry traffic (1920) includes about 2,500,000 vehicles and 48,000,000 passengers annually, of which 61 and 77 per cent respectively go by way of the Market St.-Federal St. ferry. Something over one-fourth of the total of passengers goes to the railway trains on the Camden side, but the larger local passenger traffic indicates the need for bridge shuttle trolley car service in addition to rapid transit car service over the bridge.

With respect to vehicle traffic, a census of origin and destination of traffic was taken on three representative week days of December, 1920, with returns from 16,269 vehicles. Because of the season, this census did not cover the farm produce trucking to Philadelphia or the coast-resort passenger touring; on the other hand, it covered the daily commercial vehicle interchange, and the long distance traffic, which two classes are stated to constitute 80 per cent of the total present ferry traffic. From the resulting data the centers of origin and destination of vehicular traffic on each side of the river were determined as marked on the map herewith; the Philadelphia center of traffic is at Tenth and Filbert Sts., while that in Camden is considerably farther south. The farm produce traffic (10 per cent of the total) is directed largely south of Market St., but summer passenger automobile traffic is mainly north of Market St., on account of the distribution of the outlying district of Philadelphia. With respect to the traffic included in the ferry census, the street distances by the five bridge routes considered from the Philadelphia traffic center to the Camden center were computed to be, Market St. route, 2.54 miles; Washington Square route, 2.65 miles; Franklin Square route, 2.9 miles; Lombard St. route, 3.0 miles; Spring Garden St. route, 3.6 miles.

Future traffic development was considered, but no reason was found for believing that the objectives of the cross-river traffic movement in Philadelphia would shift southward, especially as the center of population and of industry are both located north of Market St., as shown.

A forecast of future vehicle traffic across the river, using the rate of increase shown by ferry traffic for the past twenty years, indicates a parabolic curve with a present average daily traffic of 6,500 vehicles, an average daily peak hour of 550, a maximum daily traffic of 10,000 vehicles, and a maximum rush-hour demand of 1,250 vehicles. In 1926 it is estimated that the maximum hour's demand would be 2,000 vehicles, and in 1931 it would be 3,000, if the growth were no faster than that obtaining with the ferries alone.

Effect on Bridge Location—As Market St. and Federal St. are the east and west axes of Philadelphia and Camden respectively, a bridge connecting these streets would be central. But a bridge on Market St. would produce intolerable congestion in that thoroughfare, it was considered, and the structure would destroy the present ferry terminals and the most highly developed industrial section of Camden. The cost of land for approaches also would be excessive. In consequence the Market St. site was early eliminated. A Market St. location with two-branched approaches was rejected for the excessive cost of the double approaches and the necessary elevated plaza at the junction of approaches and main span. The Lombard St. site was rejected on account of its great distance south of Market St., held to be completely at variance with the Philadelphia traffic requirements. Further, the probable greater depth to rock and the slightly greater length of span at this site would have increased the cost. More detailed consideration was given to the other three sites—Washington Square (or Locust St.), Franklin Square (or Race St.), and Spring Garden St.

In comparing these three, the board concluded from the traffic studies that the principal demand of vehicle movement, both local and through, was for a location north of Market St., this requiring a shorter distance of travel through Philadelphia streets. The New Jersey Highways converge to the region of Sixth and Market Sts. in Camden, and with respect to through traffic any location with terminus convenient to this point would be satisfactory.

The Washington Square location was held to be objectionable because of being south of Market St., its greater cost, ($38,000,000, or 31 per cent greater than the Franklin Square structure), the inevitable absorption of Washington Square in the bridge plaza, and the reconstruction of the Camden trainshed of the Pennsylvania R.R. which it would require. Objections to the Spring Garden St. location lay essentially in the remoteness of the bridge from the heart of the city (Market St.), interference with a yard of the Philadelphia & Reading R.R. on the Philadelphia side, and with ferry terminals on the Camden side. The cost of the Spring Garden St. bridge, at first thought to be lower than a Franklin Square bridge, was found on the contrary to be somewhat greater.

The reasons for the resulting choice of the Franklin Square site may be summed up in the fact that this site was concluded to "convey traffic to its desired destination with economy and directness." Street widening of moderate amount was found sufficient for proper traffic distribution in Philadelphia: at first Vine St. from Sixth to Broad, Sixth St. or Eighth St. to Market, and Ridge Ave. from Vine to Broad, to about 80 ft. width, and later (as part of a traffic circuit planned by the city) a number of other streets.

Costs were estimated for bridges at Washington Square, Franklin Square, and Spring Garden St., at totals of $38,650,000, $28,871,000, and $29,480,000, the cost figures thus also favoring the Franklin square location.

River Clearance Requirements—Request was made by the board to the War Department for approval of a bridge structure providing a single span between pierhead lines at a clear height of 135 ft. for the central 800 ft. of the span. After a public hearing and consideration of the shipping and naval interests affected, this request was granted. Demand had been previously made by commercial and shipping interests for greater clearance, but the evidence presented by the board of engineers in favor of the lower clearance appeared to cover all the factors involved.

The board urged that the East River bridges at New York City have a clearance of 135 ft. (133 ft. for the Brooklyn Bridge) above mean high tide, and that both merchant and naval vessels are built accordingly; that lower clearances exist in other important thoroughfares of the world (Kiel Canal, 138 ft.; Manchester Canal, 74½ ft.; Willamette River, Portland, 135 ft.); that all the U. S. Shipping Board vessels would be suited by a 135-ft. clearance, and all naval vessels with top masts housed; that of five months' shipping traffic at Philadelphia, every one of 710 steamships and all but nine sailing vessels could have passed under the proposed bridge; that sailing vessels generally dock in the south part of the city, and 80 per cent of all shipping docks below the Franklin Square location; and that the only vessels which could not pass, the largest liners of foreign construction would pass under the bridge by arranging to house their top masts.

Capacity of Bridge—Highway traffic being the principal service to be accommodated, the roadway capacity was the first point to be investigated. A study was made of the operation of the roadways of the four

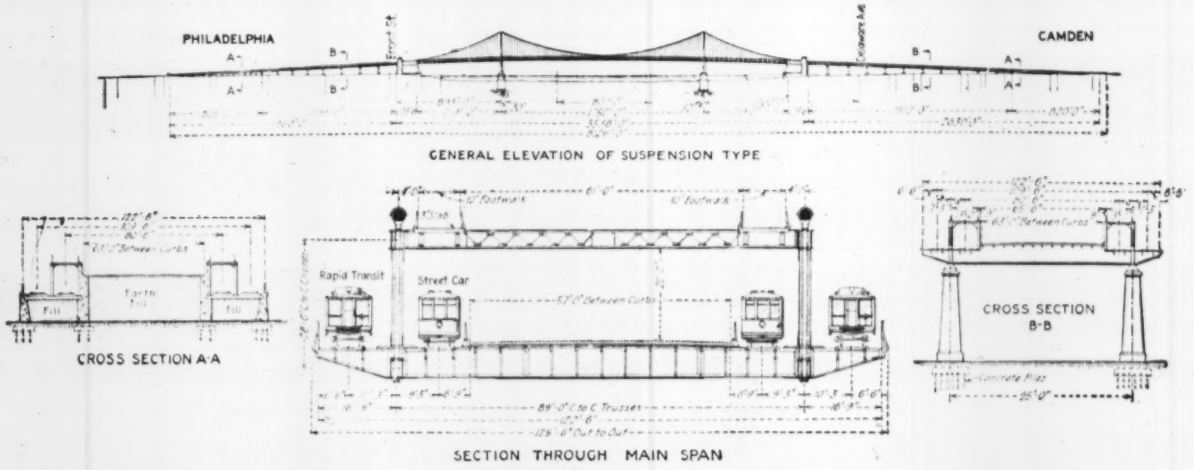


FIG. 3. SUSPENSION BRIDGE RECOMMENDED BY BOARD OF ENGINEERS—TWO PARALLEL-WIRE CABLES, SHALLOW STIFFENING TRUSSES, AND SIX-LANE ROADWAY

In view of the necessity of providing bridge shuttle-car service and separate rapid-transit service, two tracks in each direction were also provided, outside of the 57-ft. roadway; and two 10-ft. pedestrian ways were considered necessary.

For the vehicle roadway and the tracks, maximum grades in the neighborhood of 3 per cent and 5 per cent respectively were considered desirable limits. The actual design allowed the maximum roadway grade to be kept down to 3½ per cent and the track grade to 5 per cent, except for 5.22 per cent grade for a short length of the rapid-transit approach.

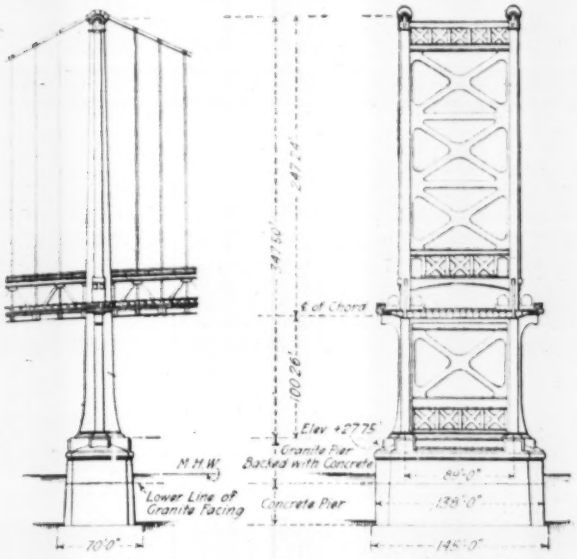


FIG. 4. FLEXIBLE STEEL POSTS WITH CABLES ANCHORED TO SADDLES

Loads—Congested or extreme loading was computed at 2,000 lb. per foot of rapid-transit track, 1,500 lb. per foot of surface-car track, 70 lb. per square foot of roadway, and 50 lb. per square foot of footway, making a total of 11,990 lb. per lineal foot of bridge. Therefore, 12,000 lb. per foot was taken as the congested or emergency loading and half this amout as normal full loading (infrequently reached). Other assumptions were: Floor load, 30-ton concentration; impact on floor and direct carrying parts, but not on main members; wind, 50 lb. per square foot exposed area; temperature variation, 55 deg. from normal.

High-strength alloy steel was decided upon for the main parts of the structure, and high-carbon steel wire for cables and hangers of the suspension bridge design. A unit stress of 72,000 lb. per square inch in the cable wires was considered permissible under the emergency live loading and 60,000 lb. under normal full loading.

Type—With a distance of 1,690 ft. between pierhead lines or 1,750 ft. between pier centers at the Franklin Square location, only suspension and cantilever structures were considered available. Arch construction was believed out of the question because of the depth to rock. The advantage of superior rigidity possessed by the cantilever bridge was believed to be negligible in highway service. The cantilever saves a large item of cost in simpler anchorages and approach construction. The suspension bridge, on the other hand, is not only very much lighter, but was considered to involve less risk in construction, to be adapted to subdivision of contracts, to require less time to build, and to be cheaper in maintenance on account of having less metal exposed. It was also considered to have the esthetic advantage over the cantilever bridge.

Detail designs and comparative cost estimates showed a difference of $1,986,000 in favor of the suspension bridge. The weight of metal in the two structures was 47,000 tons for the cantilever and 33,000 tons for the suspension bridge (the latter including more costly material and more expensive anchorages, however). The cost comparison, the greater ease and safety of erection, and the shorter time required for construction were the reasons for deciding to recommend the suspension bridge.

Suspension Bridge Design—As the proposed span exceeds by 150 ft. the longest existing suspension bridge span in the world its design elements are of exceptional interest.

Suspended side spans were adopted, since the local conditions require that the anchorages be set a considerable distance back of the towers. Street conditions made it convenient to fix the length of the side spans at slightly less than half the main span, a desirable ratio. The sag of the cables was set at 200 ft., as the most desirable compromise between increased cost of towers and increased stresses in stiffening trusses, cables and anchorages.

In fixing the width of the bridge the deck arrangement had first to be determined. It was desired to avoid double-deck construction because of the complication of the approaches resulting therefrom. By placing the footways on the upper lateral bracing, a single deck of practicable width was obtained. A single roadway was

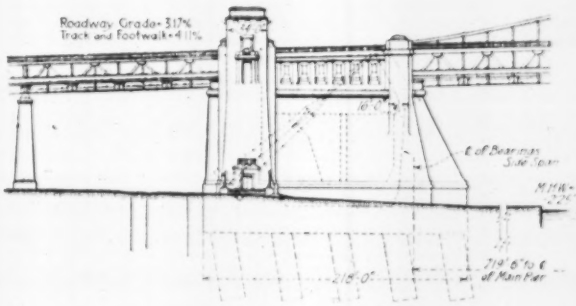


FIG. 5. ANCHORAGE WITH INCLINED CYLINDER FOOTINGS

considered desirable. The deck arrangement resulting is shown by a cross-section. The spacing of main cables is 89 ft.; a two-cable arrangement was considered preferable to a four-cable. This called for 30-in. cables, which represent a large increase over the 15¾-in. cables of the Brooklyn bridge, or even the 18⅝-in. and 20½-in. cables of the Williamsburgh and Manhattan bridges. Each cable will be composed of 16,500 parallel wires, 0.192 in. diameter.

Hangers, spaced about 20 ft., consist each of four 2⅝-in. galvanized wire ropes attached to a cast-steel saddle. A short panel length was considered desirable for the stiffening trusses (20.5 ft. for main span, 20.75 ft. for side spans). The trusses are relatively shallow (28 ft.), for economy and for efficient distributing function of the suspension system as a whole. The trusses are of simple triangular web system, are continuous across the span, and are supported at the towers by stiff hangers.

As in the Manhattan bridge, the towers are solid built steel posts bearing the cables firmly attached to their saddles (instead of having movable saddles on rollers). The necessary bending of the towers is allowed for in the design. The cross-section of each post increases from 7 x 12 ft. at the top to 7 x 40 ft. at the base.

A simple steel floor system, a concrete slab roadway structure with wood block paving, and open tie floors for the railway tracks constitute the essential features of the deck. The pavement, the only inflammable

material used in the bridge, is considered to be free from fire danger because of its support on a concrete slab.

Careful attention to proportions in the design of masonry and other details was depended upon for beauty of appearance. The results are evident in the general drawings.

Of the total cost of the suspension design for the Franklin Square site, $22,479,000 represents construction cost and $6,392,000 real estate cost. The construction cost, in turn, is made up of $13,355,000 for the main bridge, $6,468,000 for the approaches, plazas, sewer and grade revision, etc., and $2,656,000 for engineering administration and contingencies. The board of engineers believes that the design recommended can be completed by July 4, 1926.

The board consists of Ralph Modjeski, chairman, George S. Webster, and Laurence A. Ball. Its engineering staff included L. S. Moisseiff as consulting designing engineer, Paul P. Cret as architect, Arnold W. Brunner as consulting architect, Clement E. Chase as principal assistant engineer, and E. B. Bergendahl as chief draftsman and assistant engineer. The news article in last week's issue erroneously stated, p. 1052, that Mr. Webster was chairman of the board of engineers.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Concerning Business Prophecy

Sir—Regarding your editorial "Gary Hopeful" in the issue of June 2, p. 921, let us hope he is nearer right in his views on the business outlook than he was a little over a year ago when he "could see no dark clouds ahead" and was predicting three to five years of prosperity for the United States. Our political economists' views of the future business conditions have been nearer correct in the past two years than our big business men like Gary, Schwab and Ryan.

R. E. WHITE.

Los Angeles, Cal., June 10.

A Rainmaker's Contract with Alberta Farmers

Sir — In January of this year a contract was executed between the United Agricultural Association of Medicine Hat, Alberta, Canada, and Charles N. Hatfield, a professional "rainmaker," which has some features that will interest irrigation engineers. The chief features of the contract are as follows:

"Said Hatfield hereby agrees to construct and build a rain precipitation and attraction plant at a favorable site to be chosen by him for its operation. Said plant to be kept in constant operation from the first day of May, 1921, to the first day of August, 1921, in the endeavor to bring about the largest possible increased precipitation over and about that portion of Alberta, Canada, within a radius of 100 miles of the city of Medicine Hat. The operations of said Hatfield tend to contribute a 100 per cent increase over and above natural rainfall.

"It is hereby understood and agreed that all rain falling from the first day of May, 1921, to the first day of August, 1921, in the above district that said Hatfield, through the efforts of his operations on the atmosphere, shall be given credit for one-half of the precipitation that falls, at a uniform rate of $4,000 per inch up to 4 in. or fraction thereof. The maximum consideration of this contract being $8,000 for a 4-in. rainfall. All rainfall in excess of 4 in. no extra charges whatsoever."

In a letter to R. S. Stevens of Gulf Lake, Sask., Mr. Hatfield, in referring to his Alberta contract states, "The fact is that these operations upon the atmosphere produce an increase upon the rain that falls naturally. Whatever your natural rainfall is to be, a 100 per cent increase is the result. My contract calls for the maximum of 4 in. during this period, but I wish to state for the benefit of the united farmers of Alberta that this amount will be far exceeded. Candidly I believe that with the powerful operations that are to be conducted this summer in your field that fully 8 or 10 in. will be forthcoming."

It is interesting to note that records of the Weather Bureau Station at Medicine Hat since 1884 show that in only nine of those 37 years has the precipitation been below 4 in. during the three months period covered by this contract and that the average over this 37-year period is 6.04 in. for the three months mentioned. Hence it may be concluded that a 4-in. rainfall during the summer of 1921 could quite reasonably be expected.

K. T. ROBERTS.

Los Angeles, Cal., June 10.

Concrete Casing of Steel Chimneys

Sir—In *Engineering News-Record* of May 19, p. 855, a description is given of the "felling of four steel chimneys lined outside with concrete," these chimneys being taken down for the reason that they tilted as much as 4 ft. 8 in. out of perpendicular and for this reason the concrete lining was not successful. In *Iron Age* of April 28, 1921, a case is cited of four stacks larger and taller than the ones previously referred to and apparently treated in the same way, but after two years an inspection revealed nothing by way of defect excepting superficial cracks.

The difference between the method of applying the concrete in the two cases, in the former case the concrete having been applied to the stocks when they were cold and in the latter case when they were hot, may have been the cause of different results. We do not understand that the stacks which you mention were lined with brick, but it would be interesting to know the cause of successful installation in one case as against unsuccessful installation in another case.

LUKENS STEEL COMPANY,
Alfred Goodfellow, Chief Construction Engineer.

Coatesville, Pa.; June 3.

[It is a fact that large numbers of steel stacks have been cased with reinforced concrete by the cement-gun process with successful results. The reasons for failure of the four stacks at Kewanee are given in the following letter.—Editor.]

Sir—Replying to your inquiry of June 9, regarding concrete encased steel smokestacks in our plant, we are pleased to give you the following information relative to their construction and service. The chimneys were unlined, self-supporting steel stacks, erected in the winter of 1912 and 1913. In 1916 they were enclosed in a concrete shell 6-in. thick at the bottom and 5-in. at the top. This concrete was placed while the stacks were cold, the steel forming the inner form.

Soon after the stacks were put in service after they had been encased, cracks developed in the concrete, gradually becoming worse, and before the oil fuel had been used we had discussed seriously the matter of replacing them. The stack serving the fourth boiler, in which no oil was used, disintegrated more rapidly than the others and has already been replaced, indicating that the use of oil as fuel in the furnaces was not directly concerned with the failure of the concrete. We believe that the failure of the concrete shells was due to three causes: (1) Poor quality of concrete; (2) no provision for expansion of the steel; (3) insufficient time allowed for the concrete to set before the boilers were put in service.

WALWORTH MFG. CO. (Kewanee Works),
By C. S. STAUFFER, Works Engineer.

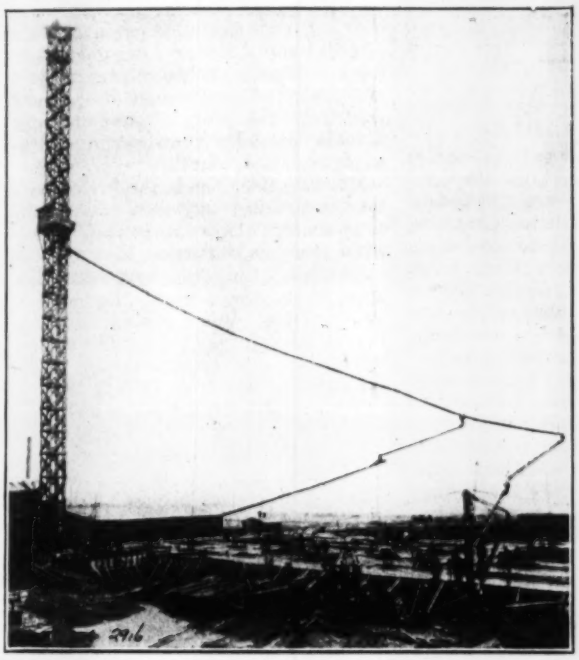
Kewanee, Ill.; June 13, 1921.

HINTS FOR THE CONTRACTOR

Contractor Saves Rope in Hanging Chutes

BY C. W. GARRISON
The Lakewood Engineering Co.

THE Arthur Tufts Co. employed an economical method of hanging concreting chutes on the construction of the new Coca-Cola plant at Baltimore. From the load line, which is hung over the top of the tower, single lines of wire rope were dropped to which were attached the regulation double and single manila rope



CHUTE SUSPENDED FROM LOAD LINE WITH MANILA ROPE BLOCKS

blocks for raising and lowering the chutes. Each single line of wire rope takes the place of a double length of manila, and also shortens the length of lead line.

Power Operated Scraper Shortens Haul on Tunnel Muck

IN THE process of enlarging tunnel sections on the Southern Pacific Railroad over the Techahapi grade, muck is brought out of the tunnels on the down grade by gravity in ½-cu.yd. dump cars and the cars are pushed back up grade by hand. Where the approach to the portal is for some distance in cut, so that a haul considerably beyond the portal would be necesasry to reach a point where the muck cars could discharge on a dump, it has sometimes been found economical to install near the portal a power-operated scraper for handling muck over the outer bank of the cut. Where the outer bank is not too high this operation is not costly, the power rig is operated by one man and considerable saving is made in getting muck cars and men back into the tunnel quickly.

The accompanying installation shows the tunnel muck cars dumping into a cut made at right angles to the

MUCK CAR DUMPING INTO CUT

track in which a scraper is operated back and forth by means of snatch blocks at each end of the haul. A gasoline engine that supplies the motive power for the scraper is just out of the picture to the left.

Dry Masonry Laid as Riprap

BY F. W. EPPS
Bridge Engineer, Kansas State Highway Commission

THIS job of riprap on federal-aid road project No. 6 in Bourbon County, Kansas, is notable for the care which was exercised in laying up the slopes to true lines and carrying the slope around the bridge abutments on true curves. The masonry was laid to a series of lines stretched from the shoulder to the toe of slope.

LAYING RIPRAP SLOPES TO TRUE LINES

The stone for this work was hauled 2½ miles from an old rock fence; 270 cu.yd. of rock were hauled which covered 711 sq.yd. of riprap. The following data was obtained:

Cost of Rock	$40.50
Cost of Loading	108.35
Cost of Labor in Hauling	170.50
Cost of Gas and Oil	98.09
Cost of Dressing Slopes	78.30
Cost of Laying Rock	385.75
	$881.49
Less Rock used Elsewhere	55.65
	$837.14

or $1.18 per square yard of paving in place.

This work was under the supervision of the Kansas State Highway Commission, Blair Boyle, resident engineer, and L. P. Scott, division engineer.

NEWS OF THE WEEK

New York, June 23, 1921

Delaware Bridge Commission Holds Hearings

Public hearings to consider arguments for and against the several sites advocated for the Delaware River bridge (Philadelphia to Camden) were held by the Delaware River bridge Commission during the past week. These hearings followed the report of the board of engineers, rendered June 9 as noted in last week's issue, p. 1049. A detailed report on the engineering features of the structure selected appears on p. 1086 of this issue.

Three new members were recently appointed to the Pennsylvania commission, one to fill a vacancy. They are Samuel M. Vauclain, president of the Baldwin Locomotive Works; Richard Wegelein, of the Philadelphia City Council, and Thomas J. Jefferies. Mr. Vauclain has hitherto been active in discussion of the bridge project as an advocate of the Spring Garden St. location, the most northerly of the five sites considered by the board of engineers. He has stated, however, that as a member of the commission he will have no bias in favor of any location. The board of engineers reported in favor of a more southerly location at Franklin Square, Philadelphia.

To Hold Conference on International Standards

The conference of secretaries of national standardizing bodies held at London recently reached the view, as reported by Dr. P. G. Agnew, secretary of the American engineering standards committee, that international co-operation in industrial standardization work should proceed along informal lines, and that attempts to form a general international standardizing body are not desirable at the present time. However, arrangements are being made for close co-operation between the national standardizing bodies and the International Chamber of Commerce, which will give special consideration to standardization at its convention in London during the week of June 27.

The meeting of secretaries was attended by R. J. Durley, for Canada; G. Gerard, for Belgium; C. le Maistre, for Great Britain; E. Hijmans, for Holland; A. Eriksen, for Norway; M. Zollinger, for Switzerland, and Dr. Agnew.

Arkansas Seeks Highway Engineer

A state highway engineer in Arkansas is wanted to replace V. P. Knott, recently resigned. The salary of the position is $5,000 a year. Applications may be addressed to Herbert R. Wilson, state highway commissioner, at Little Rock.

Denver Water Bonds Not Voted

The $5,000,000 bond issue for conduits, filters and distribution mains for the Denver water-works system voted upon May 19 were defeated despite the efforts of the business associations and a strenuous educational campaign indicating that delay would likely result in a water famine next season. Petition for a separate election this fall on the water question alone will be filed as soon as it is legally possible to do so.

Bill to Amend Valuation Act Opposed by Carriers

At hearings held June 10-11, before the Senate committee on interstate commerce counsel for the carriers opposed a bill introduced by Senator Cummins, chairman of the committee, to relieve the Interstate Commerce Commission of the duty of reporting separately the "present cost of condemnation and damages or of purchase in excess of such original cost or present value" of carrier lands. The bill if passed would amend the Valuation Act by striking out that portion requiring the Interstate Commerce Commission to find and report separately such additional costs of acquiring right-of-way. Hearings were held before the subcommittee during May and its members indicated that they favored the amendment. In the hearing held June 10 and 11 before the entire committee, however, a decided sentiment against the amendment was indicated on the part of some of the committee members.

Passage of the bill would halt the work of ascertaining present cost of acquisition of railroad lands over and above acreage value of adjoining lands, now being carried on by the Interstate Commerce Commission in obedience to the writ of mandamus issued by the Supreme Court in the Kansas City Southern case, March, 1920. The view is held that passage of the amendment would also amount to legislative approval of the methods so far used by the Interstate Commerce Commission of determining "present value" of land since it would constitute a virtual reenactment of that portion of the Valuation Act with the knowledge of Congress of methods so far used and reported to it by the Interstate Commerce Commission.

It is expected that the bill will be reported out of committee for vote by the Senate before the close of the month. It is sponsored by Director Prouty, of the Bureau of Valuation, and by John E. Benton, general solicitor, National Association of Railway and Utilities Commissioners.

John Fritz Medal Awarded to Eugene Schneider

The John Fritz medal board of award has awarded its gold medal and diploma to Charles Prosper Eugéne Schneider, the distinguished French engineer, scientist and man of affairs. The following cable has been sent to his home in Paris: "John Fritz medal board of award representing national societies of civil, mining and metallurgical, mechanical, and electrical engineers, has awarded you the Jonh Fritz gold medal for achievement in metallurgy of iron and steel; for development of ordnance, especially the 75-mm. gun; and for notable patriotic contribution to the winning of the war."

Mr. Schneider heads the great Creusot engineering and steel works and shipbuilding plants of France, which, with their subsidiaries, have 100,000 employees. No industrial establishment in the whole world, the board of award states, made a greater contribution to the defense of liberty or showed more wonderful resourcefulness under the stress of war from 1914 to 1918.

Not only did Mr. Schneider and members of his family fill leading places in the industrial and scientific defense of civilization, but his three sons also fought and received honors. Two were in the aviation service, and one in the artillery. The eldest was killed in an air fight in 1918.

Railroad Committee to Work With New York Port Authority

A board of eleven engineers, representing railroads terminating at the port of New York, was appointed June 16 by the presidents of the railroads to co-operate with the Port of New York authority in developing a plan to solve the railroad terminal problems of the port. This action was determined upon at a meeting of eastern railway presidents in New York, June 10, called by Samuel Rea of the Pennsylvania system. The board of engineers consists of: H. A. Lane, chief engineer, Baltimore & Ohio R.R.; A. E. Owen, chief engineer, Central Railroad of New Jersey; G. W. Kittridge, chief engineer, New York Central Lines East; G. J. Ray, chief engineer, Delaware, Lackawanna & Western R.R.; G. T. Hand, chief engineer, Lehigh Valley R.R.; R. C. Falconer, assistant to the president and chief engineer, Erie System; L. V. Morris, chief engineer, Long Island R.R.; E. Gagel, chief engineer, New York, New Haven & Hartford R.R.; J. H. Nuelle, general manager, New York, Ontario & Western Ry.; E. B. Temple, assistant chief engineer, Pennsylvania System, and S. T. Wagner, chief engineer, Philadelphia & Reading Ry.

Amendments Made in Dowell and Townsend Bills

Proposed Federal Commission Reduced From Five to Three Members—66-Ft. Width Eliminated

(Washington Correspondence)

In recommending last week that the Phipps bill, with the Dowell rider, be passed, the House committee on roads explained that the measure has been amended so as to give states whose constitutions and laws might have to be changed as much as three years to meet the requirement as to the state's being the unit for dealing with the federal government and for attending to highway maintenance by the state.

Another change provides that 50 per cent of the appropriation for forest roads is to be expended on roads embraced in or constituting necessary extensions of the main systems of roads. The remaining 50 per cent of the allotment is to be expended by the Secretary of Agriculture for forest roads as the necessity may require. If at any time the annual appropriation exceeds $6,000,000 the amount in excess is to be used entirely on main highways.

TOWNSEND BILL CHANGES

The Townsend bill, as finally agreed upon by the Senate committee on post offices and post roads last week, has been amended so as to reduce the proposed federal highway commission from five to three members. Another amendment provides that no salary, except that of the chief engineer, shall exceed $5,000 per annum and that the salaries to be paid other employees shall not exceed those paid in other departments for similar service.

In an effort to meet the objection that the state highway commissions would have too little voice in the selection of the roads, the bill was amended so that the federal commission would select these roads "in co-operation with the several state highway departments."

In providing for the situation which will arise if a state should refuse to co-operate in the construction of secondary highways, the committee adopted a proviso as follows: "If any state highway department fails, neglects or refuses to so co-operate or agree with the commission, the commission may then determine the selection, designation and establishment of the route or routes."

So as to make the maintenance clause stronger, the commission is given the additional authority to refuse approval of projects in any state until a proper condition of maintenance has been established. If it should be necessary for the federal commission to place the highway in proper condition, the cost is to be charged against the funds allotted to the state. At that point this provision was added: "Upon the reimbursement by the state of the amount expended by the federal government for such maintenance, said amount shall be paid into the federal highway fund for the benefit of said state in the construction of other roads under this act, and the commission shall then approve further projects submitted by the state."

The committee struck out the section of the original bill providing for a right-of-way not less than 66 ft. wide and inserted the following language: "That all highways in the interstate system constructed after the passage of this act shall have a right of way of ample width and a wearing surface of an adequate width which shall not be less than 20 ft., unless in the opinion of the commission it is rendered impracticable by physical conditions, excessive costs, probable traffic requirements or legal obstacles."

Ideal Highway Section to Be Built in Indiana

The State of Indiana, through its state highway commission, has entered into a contract with the Lincoln Highway Association to provide $33,000 per mile to aid in the construction of an ideal section of the Lincoln Highway, to be built in Lake County, Ind. The association's plan provides for the construction of two miles of the ideal road. The specifications call for a 100-ft. right-of-way and a pavement 40 ft. wide of 10-in. reinforced concrete. Sub-surface drainage and the beautification of the outer 25 ft. of the right-of-way on each side. The ideal section will also be lighted for night traffic in accordance with plans now being prepared by the illuminating experts.

N. C. Licensing Board Meets

The North Carolina board of registration for engineers and land surveyors, created by the General Assembly at its 1921 session, held its initial meeting in Raleigh on May 23. Charles E. Waddell of Asheville was elected chairman, Gilbert White of Durham, vice-chairman, and Prof. Harry Tucker of Raleigh, secretary-treasurer. The board hopes to send out application blanks to the engineers in the state in the course of the next few weeks. The other members of the board are Prof. P. H. Daggett of the State University and N. S. Mullican of Mocksville.

Chief Engineer of Doherty Co. Is New N. E. L. A. President

Milan R. Bump, since 1910 chief engineer of Henry L. Doherty & Co., in charge of all engineering and of the construction and operating departments of the public utility division, was elected president of the National Electric Light Association on June 3. The convention of the association was held in Chicago. Mr. Bump, for four years vice-president of the association, succeeds Martin J. Insull.

Idaho License Examination

The next examination for Idaho civil engineers and surveyors seeking licenses will be held in Boise Sept. 13. Application blanks and full information may be had from the Bureau of License, Capitol Building, Boise, Idaho.

Colorado Floods Again Threaten Imperial Valley

The annual flood waters of the Colorado River are threatening the dikes and levees that constitute the first line of defense of the Imperial Valley in Southern California. Although the flow this season has not been as large as that of last year, the gage height is above last year's maximum due to the silting up of the channel. Several hundred men have been strengthening the Saiz and Ockerson levees with sand bags, but on June 14, according to press reports, efforts to save the Saiz levee were discontinued after it had been submerged by back water coming around the lower end of the Ockerson levee. The latter might hold, it was believed, although it had become well saturated, and there was danger that the levee might "sugar away" in several places.

Directors of the Imperial Irrigation District are stated to have voted $20,000 to construct a railroad two miles long from an old quarry to the Ockerson levee to deliver rock for strengthening the levee. The present danger is believed to be chiefly to land south of the international line. The Volcano Lake levee protecting land north of the line was intact on June 14, at which time, however, the water was not believed to have reached its highest level. The Volcano Lake levee has had a free-board of more than 3 ft. on previous floods, its water face has been well rip-rapped and a railroad has been laid on top for practically the full length.

Five New Engineer Colonels

The following engineer officers were nominated in May by the President to be promoted from the rank if lieutenant colonel to colonel: James A. Woodruff, William Kelly, Lewis H. Rand, Edward M. Markham, Thomas H. Jaskson.

The following engineer officers have been detailed as instructors at the General Service Schools at Fort Leavenworth, Kansas: Major Richard C. Moore, Major Mark Brooke, and Major Warren T. Hannum.

Engineering Educators to Meet

The Society for the Promotion of Engineering Education will hold its annual meeting at New Haven, Conn., June 28-July 1, 1921. The discussion will be divided into three general topics, namely, the curriculm, the student, and the faculty. Following the address by President Hadley of Yale, William H. Burr, professor emeritus of civil engineering, Columbia University, will speak on "General Studies in the Engineering Curriculum," to be followed by Dr. W. F. M. Goss, on "Engineering Teaching and Practice." Included in the discussion under the second topic is a paper, "Some Results of the Co-operative System," by J. W. Hallock, director of co-operative work, University of Pittsburgh. Discussion of "The Faculty" will consist largely of a symposium on the training of engineering teachers.

A. A. E. and F. A. E. S. Confer

Informally and unofficially, June 3, at St. Louis, previous to the meeting of the executive board of the American Engineering Council, representatives of that body conferred with officials of the American Association of Engineers for the purpose of finding a way to develop closer relations between these two national organizations.

Unanimous conclusions were reached to the effect that: (1) there should be unity in the profession; (2) duplication of effort is undesirable and an economic waste; and (3) it is desirable to create a conference committee to consider closer co-operation. At the meeting of the executive board of the council a committee consisting of the presiding officers, C. W. Townley, L. W. Wallace, secretary and D. S. Kimball, dean, mechanical engineering, Cornell University, was appointed to confer with the A. A. E. representatives.

Alameda Naval Base Rejected

By a non-partisan vote of 40 to 30 the Senate, on May 23, voted out of the naval bill an appropriation for $1,500,000 for development of the $100,000,000 naval base recommended by the joint Congressional naval committee for Alameda, Cal. The relative advantages of this site and two others on San Francisco Bay—one at San Francisco and the other at the existing navy yard at Mare Island—were noted in *Engineering News-Record*, Dec. 30, 1920, p. 1290. The Alameda site won out in the report of the committee which investigated the sites, but the current action of the Senate postpones, at least the prosecution of the project.

Kimball Named for A. S. M. E. Head

Dexter S. Kimball, dean of the college of engineering, Cornell University, was nominated president of the American Society of Mechanical Engineers in the report of the nominating committee for 1921, submitted to the society's council May 24 at the spring meeting of the society held in Chicago May 23-26. Dean Kimball has been active in the work of the society, having been chairman of the committee on meetings and programs and member of the committee on organization. He is a vice-president of the Federated American Engineering Societies.

Endorse Completion of U. S. Maps

The board of direction of the American Society of Civil Engineers, at its meeting June 6, passed a resolution endorsing House bill 5230, now pending at Washington, D. C., which provides for the completion of the topographic surveys of the United States. The preamble to the resolution states that with the completed topographic maps the saving in cost of public and private works constructed in the next decade will more than offset the expense involved.

Michigan Legislature Passes Port District Resolution

The resolution which aims to form port districts of cities in Michigan on the Great Lakes was passed by the House of Representatives of the Michigan Legislature June 7, by a vote of 69 to 16. This action provides for submitting the question to the voters at the next regular election. The purpose of the measure is to create means of administration for the development of ports in connection with the proposed St. Lawrence waterway.

Federal Commission for Waste Elimination Proposed

A federal commission to study waste elimination in industry is proposed in a bill which has been introduced by Senator Calder. The bill is intended to continue and to amplify the survey made by the Federated American Engineering Societies at the instigation of Herbert Hoover, who at that time was president of the organization.

Senator Calder's bill provides that the commission is to be known as the United States Industrial Waste Commission. It is to be composed of seven commissioners "of eminent attainment," appointed by the President. The bill specifies that the Secretary of Commerce is to be the chairman of the commission. The commission is directed by the bill to make a final report on or before Sept. 21, 1922, covering waste in "timber, power, transportation, oil, coal, essential minerals and other basic raw materials," and to recommend improved methods and means of eliminating intermittent and seasonal production. The commission is to serve without salary.

Favor Cape Cod Canal Purchase

Congress is to be asked by the Secretary of War to approve the purchase of the Cape Cod canal by the government for $11,500,000. The canal company was taken over by the Railroad Administration during the war and administered by it until Feb. 25, 1920. The canal company declined to take back the property, claiming that it had been purchased by the government. It has been operated by the War Department since control was relinquished by the Railroad Administration.

Some time ago the Secretary of War tried unsuccessfully to reach an agreement as to the price which should be paid by the government for the property, and condemnation proceedings were later instituted by the Attorney-General. The District Court approved the valuation of $16,651,000. This judgment was not sustained by the Circuit Court of Appeals, which was of the opinion that various errors existed in the method of computing and ascertaining the value of the property. The price of $11,500,000 was agreed upon by the Secretaries of War, Navy and Commerce.

Engineers Before Labor Board

The Southern Pacific Railroad cited the Southern Pacific Section of the American Association of Engineers to appear before the U. S. Labor Board June 6 for the adjustment of railroad compensation and working conditions. This appearance was brought about in connection with an effort of the company to reduce salaries of engineers and at the same time a request of the engineers for an increase. C. E. Drayer, national secretary, R. C. Bailey, in charge of chapter activities, and W. H. Phelps of the A. A. E. section, represented the engineers.

The argument cited the differential in compensation operating against the technically-trained professional men and the application, on the part of the railroads, of decision 2 of the U. S. Labor Board which did not specifically mention the professional engineer. The engineers did not appear before the board and were apparently not in its mind when decision 2 was drafted. Exhibits were presented to show that an increase rather than a decrease should be put into effect to bring the present schedule to the minimum schedule of the A. A. E. A decision is expected by July 1.

Would Establish Department of Mines

A determined movement has been launched looking to the establishment of a new federal department which will administer matters pertaining to mines and the mineral industries. Two bills have been introduced in the Senate, one by Senator Nicholson of Colorado, and the other by Senator Shortridge of California. The Nicholson bill provides that the proposed department be composed of the U. S. Geological Survey, the Bureau of Mines and the General Land Office, and absorb the functions of the War Minerals Relief Commission. The Shortridge bill is more comprehensive, in that it would include in the department, in addition to the agencies mentioned by the Nicholson bill, the Federal Power Commission, the California Débris Commission, the Alaskan Engineering Commission and the Bureau of Explosives of the Interstate Commerce Commission. In addition, that portion of the work if the Bureau of Standards and of the Indian Office which deals with mineral raw materials or mineral lands would be transferred to the department of mines. The Shortridge bill takes over only the mineral land work of the General Land Office.

Film to Picture Road Changes

A film designed to portray the evolution of road construction and administration and entitled "The Changing Road" is being produced by James W. Brooks of the American Highway Educational Bureau, Washington, D. C. It is intended for use by state highway departments, good road associations, engineering colleges and civic organizations.

Secretary Fall Against Yellowstone Park Dam

An adverse report has been made by the Secretary of the Interior on the Walsh bill in which permission is asked to build a dam across Yellowstone River at a point not more than 3 miles below the outlet of Lake Yellowstone. The object is to regulate the waters of the lake for irrigation purposes. In his report, Secretary Fall says, in part:

"I cannot favor the enactment of the measure. I do not believe it would be advisable for Congress to permit private interests to develop irrigation or power sites within the limits of existing national parks. These parks were created by Congress for the preservation of the scenery, forests and other objects of beauty and interest in their natural conditions and they are created and maintained for general and national purposes, as contradistinguished from local developments.

"If cases be found where it is necessary and advisable in the public interest to develop power and irrigation possibilities in national parks and it can be done without interference with the purposes of their creation, I am of the opinion that it should only be permitted to be done, whether through the use of private or public funds on specific authorization by Congress, the work to be constructed and controlled by the federal government."

Syndicate Buys New York Barge Canal Equipment

A large part of the New York State Barge Canal equipment previously operated by the Inland and Coastwise Waterways Service of the War Department has been purchased for $1,000,000 by a New York syndicate. The bid of the syndicate covered the purchase of the entire remaining equipment, on a deferred payment basis over a period of seven years. The initial payment is $75,000 with subsequent payments of $100,000 on Jan. 1, 1922, and $75,000 on July 1, 1922. The balance will be paid in equal monthly installments over the remainder of the period of seven years, deferred payments bearing interest at 5 per cent. The government is protected by insurance of the vessels carried by the purchaser and by bonds to cover maintenance and the first four payments. The syndicate is composed of Edward S. Hughes, E. G. Warfield, W. L. Williams, George Kern, and James G. Trainer. Its offices are at 1270 Broadway, New York City.

Reclamation Measure Progresses

The Senate committee on public lands has reported out and recommended the prompt passage of the rural homes bill, authorizing the Secretary of the Interior through the Reclamation Service to make contracts, first for the investigation and later, if found feasible, for the construction of projects for the reclamation and development of lands in private ownership located throughout the United States.

Governor of Pennsylvania Vetoes Grade Crossing Bill

The bill passed by the legislature providing for the elimination annually of 2 per cent of all of the grade crossings in Pennsylvania was vetoed by the Governor May 26. It provided that one year after the passage of the act every railroad company operating within the state should remove "at least two per centum of the total number of grade crossings on its *main* lines . . . and shall each year thereafter remove at least two per centum of the total number of grade crossings remaining upon its lines within the Commonwealth." In vetoing the bill the Governor said that its purpose was commendable, but its enforcement would be impracticable, if not impossible. It would cost one railroad, with 3,000 crossings, from $6,000,000 to $10,000,000 a year, which the Governor said would bankrupt the weaker lines.

Trestle Collapse Due to Freshet

Failure of a timber trestle under a passenger train on the Chicago & Northwestern Ry., near Whitney, Neb., June 15, was due to undermining of a few bents by a heavy freshet which occurred about two hours before the accident. Some large trees lodging against the bents caused the current to scour out the channel. The trestle had twenty-one spans about 16 ft. long and seven or eight of these failed under the train. The engine crossed safely but most of the cars were wrecked, four or five persons being killed and several injured.

Health Association Plans Fiftieth Annual Meeting

The tentative date of the fiftieth annual meeting of the American Public Health Association has been set as Nov. 13-18. The meeting will be held in New York City where the first meeting of the association for organization was held April 18, 1872. It is expected that Dr. Stephen Smith, founder and first president of the association, who is now in his 99th year, will take part in the semi-centennial celebration. Another feature of the meeting will be reviews of progress in various branches of public health work within the last fifty years. Besides the general meeting there will be the usual sectional meetings devoted to sanitary engineering, laboratory work, vital statistics, public health administration and other subjects. The secretary of the association is A. W. Hedrich, 169 Massachusetts Ave., Boston, Mass.

Adams Leaves Research Council

Prof. C. A. Adams has decided definitely to give up his work as chairman of the division of engineering of the National Research Council and to return to Cambridge, Mass., to give his full time to his work as professor of electrical engineering at the Harvard Engineering School.

Agree on New $9,000,000 Conduit for Washington Water Supply

The conferees on the Army appropriation bill have agreed to an appropriation of $200,000 to begin work on a new conduit for the conveyance of water from Great Falls on the Potomac River to Washington, D. C. This action provides for work on the project along the lines recommended in the recent report by Major Max Tyler, Corps of Engineers. At the same time the conferees agreed to strike out the Senate amendment to the bill providing another $200,000 with which to begin work on the Great Falls water-power project. It was held that since this latter development involves the ultimate expenditure of some $50,000,000, it should receive the consideration incident to a separate bill, rather than commit the Government to the project by means of a rider on a supply bill.

Washington's water supply now is dependent upon a single conduit from Great Falls. The city's water requirements have become so great that the reservoir system is inadequate to supply the needs long enough to allow the unwatering of this conduit for inspection and repair. It will require at least three years to build the new conduit. The total cost is estimated to be $9,000,000.

Falsework Failure Wrecks Large Highway Bridge

Failure of the piles supporting the falsework for a new 330-ft. riveted steel highway span across the west channel of the Connecticut River at Brattleboro, Vt., on June 16, caused the collapse of the span. The structure was under erection by the American Bridge Co. It was to replace a span destroyed by ice pressure in March, 1920, as described in *Engineering News-Record* of May 6, 1920, p. 902. A long series of bridge failures distinguishes this particular crossing, as recounted in the same article.

Flushing Bay Project Approved

Approval of the Flushing Bay improvement, projected by the Department of Docks of New York City, was voted by the Sinking Fund Commission June 9. However, the approval carries no appropriation nor does it commit the city to any particular plan of development. The plan of the dock commissioner calls for twenty-four piers, each 1,150 ft. long, 290 ft. wide, with 360-ft. slips. The estimated cost of the entire development is in the neighborhood of $50,000,000.

West Pointers Go to Rensselaer

Thirty-two officers of the Corps of Engineers of the United States Army, graduates of the class of 1920 of West Point Military Academy, have been ordered to report June 6 at the Rensselaer Polytechnic Institute for a course of study, fifty-one weeks in duration, in the department of Civil Engineering in that institution.

Am. Soc. C. E. Supports Employment Bureau of Federation

The board of direction of the American Society of Civil Engineers, at its meeting June 6, on invitation from the American Engineering Council of the Federated American Engineering Societies, decided to continue its support and receive the service of the employment bureau. The action was made retroactive covering the fiscal year from Jan. 1, 1921. Participation requires $3,000 per year, the same sum paid by the other three founder societies.

Survey Site for Colorado River Power Project

Several members of the engineering staff of the Southern California Edison Co., with G. C. Ward, vice-president of the company, have just returned from an inspection of power sites on the Colorado River. Attention was given to sites covered in the company's recent application to the Federal Power Commission for permission to develop 2,500,000 hp. at Diamond Creek and Marble Canyon. Survey parties have been sent out to obtain field data on which final plans will be based. Studies are also being made of a high voltage transmission system to convey the power from these sites into Arizona and adjoining states, as well as to points where connection can be made with existing transmission lines of the company. Early in June the company filed its application with the Arizona State Water Commission for a permit to appropriate the waters of the Colorado River for power and irrigation purposes.

Utah Water Commission Organized

The Utah Water Storage Commission recently appointed by Governor Mabey has effected an organization. The law recently passed makes the commission a board of investigation to compile data in co-operation with various counties looking to the more complete utilization of the water possibilities of the State of Utah. The commission will now endeavor to obtain enough money from the Legislature to start an investigation of the water resources of the state.

Eastern Engineers to Advise on San Francisco Bay Crossing

J. Vipond Davies, of the engineering firm of Jacobs & Davies, and Ralph Modjeski, consulting engineer and chairman of the board of engineers for the Delaware River bridge, have been retained by the San Francisco Motor Car Dealers' Association and a group of newspaper publishers to go to San Francisco and study the bay crossing problem, with a view to advising as to the best solution. According to present plans they will reach San Francisco during the coming week and will begin their studies immediately.

Proposes Colorado River Compact

In a bill introduced by Majority Leader Mondell, Congress is asked to allow Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming to negotiate and enter into a compact providing for an equitable division and apportionment among those states of the water supply of the Colorado River and of its tributaries. A condition of the bill is that the President of the United States is to participate through a representative who would look after the interests of the United States in the transaction.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Assistant Sanitary Engineer, U. S. Public Health Service, $3,225 per annum plus increase of $600 per annum effective July 1, 1922.

Junior Sanitary Engineer, U. S. Public Health Service, $2,320 per annum plus increase of $420 per annum effective July 1, 1922.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Engineers' Club of Seattle, Wash., at its weekly luncheon May 31, was addressed by Col. Riley H. Allen of the American Red Cross on "Experiences of a Red Cross Colonel in Soviet Russia."

The Washington Society of Engineers plans to expand into an engineers' club to be made up of all engineering and technical societies in the District of Columbia.

The Western Society of Engineers, at its annual dinner in Chicago, Ill., June 8, was addressed by the retiring president, Frederick K. Copeland, the incoming president, Charles H. MacDowell and by Dr. R. A. Millikan, professor of physics, University of Chicago, on "The Organization of Research in a Democracy."

The Rochester (N.Y.) Engineering Society, at its annual meeting June 10, elected the following officers: Harold O. Stewart, president, Charles C. Evans, first vice-president; Waldo G. Wildes, second vice-president; Gloster P. Havenor, secretary; Louis J. Summerhays, treasurer.

PERSONAL NOTES

JAMES W. COSTELLO, an engineer in the department of streets and public improvements, Newark, N. J., has been appointed to have general supervision over the bureau of docks.

JOHN HORRIDGE of Philadelphia, Pa., has been appointed supervising engineer in the division of street cleaning, department of public works, Philadelphia.

JOSEPH G. SHRYOCK, designing engineer, Belmont Iron Works, Philadelphia, Pa., has received the honorary degree of master of civil engineering from the Pennsylvania Military College, Chester, Pa.

MAJOR CHARLES R. PETTIS, Corps of Engineers, U. S. A., has been assigned to duty in the office of the Assistant Secretary of War.

H. L. LEVENTON, superintendent of the Placerville-Lake Tahoe unit of the Lincoln Highway, has been appointed assistant engineer and assigned to the Sacramento division, California State Highway Department.

M. C. HENGST has been appointed engineer of the Barry County, Mich., road commission.

R. W. TORRAS, formerly on construction work with the Atlantic Refining Co. at Brunswick, Ga., is now connected with the City Planning Commission, Atlanta, Ga.

I. N. LAMB of Montreal, Canada, has been appointed professor of civil engineering at McGill University, Montreal.

R. A. ROSS of the Administrative Commission, Montreal, Canada, and J. M. R. FAIRBAIRN, chief engineer, Canadian Pacific Ry., Montreal, have received the degree of Doctor of Science from the University of Toronto.

COLONEL MERIWETHER L. WALKER, Corps of Engineers, U. S. A., has been relieved as commandant of the Engineer School at Camp Humphreys and has been ordered to the canal zone to serve as engineer in charge of maintenance and operation.

MAJOR LAWRENCE FRAZIER, Corps of Engineers, U. S. A., returning from the Philippines has been given temporary station at Kansas City prior to his entrance in the School of the Line at Leavenworth in November.

FRANK P. CARTWRIGHT has resigned from the staff of the Rochester Bureau of Municipal Research to become technical secretary of the newly appointed Department of Commerce building code committee, of which Prof. Ira H. Woolson is chairman.

MAJOR THOMAS B. LARKIN, Corps of Engineers, U. S. A., has been designated as one of the representatives

on the technical committee of the War Department.

COLONEL SHERWOOD A. CHENEY, Corps of Engineers, U. S. A., has been detailed as an instructor at the General Service Schools at Fort Leavenworth for a period of four years.

COLONEL E. H. SCHULZ, district army engineer, Seattle, Wash., has been authorized to make a survey of the Lake Washington canal system, with a view to widening and deepening the canal.

DR. ERNEST F. NICHOLS, past president of Dartmouth College, and, for a year, director of physical science at the Nela Park research laboratory of the National Electric Lamp Association, Cleveland, whose election as president of Massachusetts Institute of Technology was noted in the April 28 issue, was formally inaugurated on June 8.

DR. PHILLIP WOODWORTH, since 1917 executive secretary of the National Council of Defense, has been appointed president of Rose Polytechnic Institute, Terre Haute, Ind. He was graduated with the degree of B.S. from Michigan State Agricultural College in 1886 and received the degree of master of engineering from Cornell University in 1890. In 1892 he became professor of physics and engineering in the Michigan Agricultural College and in 1899 he entered Lewis Institute, Chicago, Ill., as professor of engineering and later became dean of engineering. He has served, in a consulting capacity, the Peoples Gas Light & Coke Co., the Chicago surface lines, the Chicago Elevated Ry., the Chicago Telephone Co., and the Commonwealth Edison Co. He has written a number of text books, including "Engineering Principles."

M. R. KAYS, formerly assistant engineer for the U. S. Reclamation Servic and for eight years vice-president and general manager of the Idaho Irrigation Co., Ltd., at Richfield, Idaho, and who, during the past ten months has been associated with A. L. Harris of Los Angeles as one of the consulting engineers for the Paradise-Verde Irrigation District at Phoenix, Arizona, has joined the staff of the Beckman & Linden Engineering Corp. of San Francisco, as chief irrigation engineer and has been placed in charge of their southwestern branch office, recently established at Phoenix, Ariz. This office will specialize in irrigation and hydroelectric power engineering in the southwestern states and is now retained by a number of projects, including the $15,000,000 project of the Paradise-Verde Irrigation District, adjoining the Salt River reclamation project, for which the firm is making final surveys and preparing plans, estimates and specifications.

LIEUTENANT-COLONEL ALBERT E. WALDRON, Corps of Engineers, U. S. A., has been relieved from his assignment with the Fifth Engineers at Camp Meade, Md., and has been detailed for duty as instructor with the engineer division of the Pennsylvania National Guard.

F. M. CLARK, formerly engineering superintendent for the Barrett Co., in Canada, in charge of the construction of streets and pavements, is now construction engineer for the Maine highway commission.

CLEMENT E. CHASE, recently in charge of the New York office of Ralph Modjeski, consulting engineer, has been appointed principal assistant engineer of the Delaware River Bridge Joint Commission with headquarters in Philadelphia, Pa.

JAMES E. MALONEY, for a number of years engineer of the old state highway department, has been appointed assistant highway engineer in charge of the engineering division.

HARTLEY ROWE, manager of the Detroit branch office of the firm of Lockwood, Greene & Co., Boston, Mass., has been made manager at the Boston office.

KENNETH MOLLER, manager of the Boston office of Lockwood, Greene & Co., has been made a member of the firm.

DONALD D. SNYDER, for the past two years commissioner of public works of Rutland, Vt., has become associated with the Frissell Engineering Co., Gardner, Mass.

MAJOR DANIEL D. PULLEN, Corps of Engineers, U. S. A., has been ordered to report to the Panama Canal department for assignment as department engineer, *vice* Colonel C. S. Rich, U. S. A., retired.

OBITUARY

WARREN C. TUDBURY, expert aid, U. S. Navy Yard, Mare Island, Cal., died May 18. He was born in Salem, Mass., in 1877, and after graduation with the degree of S.B. from Massachusetts Institute of Technology in 1900 he entered the employ of the New York Central & Hudson River R.R. and served from 1900 to 1905 as draftsman, rodman, transitman. After a year or so with Westinghouse, Church, Kerr & Co., engineers, he became instructor in railroad engineering and surveying at Lafayette College, Easton, Pa. Leaving that institution in 1908 he became assistant engineer with the N. Y. C. & H. R. R.R. on construction work. He also worked on special railroad problems with Barrows & Breed, and C. M. Spofford of Boston, Mass., and had full charge of subdivision work in the foothills, Sierre Madre, Cal., for A. B. White. In 1916 he became connected with the Navy Department, Bureau of Yards and Docks, Washington, D. C.

BUSINESS NOTES

W. D. STRAYTON has resigned as assistant construction manager of the J. B. McCrary Engineering Corp. to become associated with the Wood-Rucker Construction Co., Atlanta, Ga.

THE HELTZEL STEEL FORM & IRON CO'S plant at Warren, Ohio, was partly destroyed by fire June 2. The steel fabricating department suffered mostly from the damage. The company besides manufacturing steel forms for various construction purposes, are fabricators of general plate construction.

THE HERCULES POWDER CO. has recently purchased the Aetna Explosives Co., Inc. By the purchase the Hercules Co. acquires high explosives plants in Alabama, Pennsylvania, Michigan and Illinois, black powder plants in Ohio and Alabama, and plants for the manufacture of blasting caps in New York and Canada.

THE NEW ENGLAND CONSTRUCTION CO., Boston, Mass., will henceforth be known as the William T. Reed Co.

J. M. DAVIS has been made president of Manning, Maxwell & Moore, New York City.

THE POST WHITNEY COMPANY of Cleveland, Ohio, is a consolidation of the Post Tractor Co., Cleveland, and the Whitney Tractor Co. of Upper Sandusky, Ohio. This company will continue the manufacture of the Post tractor and the Whitney tractor. The officers of the organization are: President, E. B. Cassatt; vice-president, A. B. Whitney; treasurer, C. B. Post; secretary, F. R. LePage.

M. F. NORMOYLE & SONS is a new organization with offices at Roanoke, Va., which will engage in building construction, excavation and masonry work, erection of all classes of public and municipal buildings, apartment houses, churches, etc.

THE BROWN HOISTING MACHINERY CO., of Cleveland, Ohio, announces the opening of a southern office at New Orleans, La., with Charles H. White as manager.

THE TUCKER-DAY MACHINERY & SUPPLY CO., Cleveland, Ohio, has been organized by George Day, formerly with the Browning Co., Cleveland, and recently sales manager of M. Beatty & Sons, Welland, Ont., and by D. S. Tucker, recently district sales manager of the Elliott Co., Pittsburgh, Pa. The company will specialize in drop forgings, general contractors' and power plant equipment.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Wage Differential for Building Trades Mechanics

From E. T. Thurston, secretary of the General Contractors of San Francisco, comes a memorandum on wage differentials, taking into account the relative skill and responsibility of the various trades involved, the hazards of employment, and the personal equipment of tools required. For the purpose of emphasizing the inequities of prevailing differentials he takes the carpenter as the most essential, skilful and responsible, as well as the most expensively equipped workman in the building trades and refers all other workmen to the carpenter as a base, as indicated in the accompanying table.

An index number set opposite any craft is intended to indicate in rate per cent the relative position of workmen in that craft to the carpenter, with respect to the considerations noted above. Thus, the required skill and responsibility of the common laborer is nil; that of the bricklayer 80 per cent of that of the carpenter.

WAGES IN THE BUILDING TRADES TAKING INTO ACCOUNT SKILL, RESPONSIBILITY, HAZARD AND EQUIPMENT

Trade	Skill and Responsibility	Hazard	Equipment	Combined Ratio	Scale of Wages
Bricklayers	80	72	12½	55	$3 85
Carpenters*	100	100	100	100	7 00
Cement finishers	80	60	12½	51	3 57
Concrete labor	10	100	0	37	3 50
Electrical workers	80	19	25	41	3 50
Elevator constructors	80	93	0	58	4 06
Engineer, hoisting	50	53	25	43	3 50
Hod carriers, brick	10	72	0	27	3 50
Hod carriers, plaster	15	53	0	23	3 50
Housesmiths, ornamental iron	90	65	25	60	4 20
Housesmiths, reinforced concrete	50	100	5	52	3 64
Laborers	0	100	0	33	3 50
Lathers	50	53	5	36	3 50
Marble setters	75	11	25	37	3 50
Painters and glaziers	75	120	5	67	4 69
Plasterers	90	53	12½	52	3 64
Plumbers	80	27	12½	40	3 50
Roofers, composition	10	60	0	23	3 50
Sheet-metal workers	80	83	25	63	4 41
Steel workers	50	252	5	102	7 14
Stone cutters	80	25	25	43	3 50
Stone setters	80	72	25	59	4 13
Tile setters	75	11	5	30	3 50
Teamsters	10	30	0	13	3 50

*Carpenter used as base with per cent of 100.

Ratings as to skill and responsibility and equipment are based upon a brief inquiry into the information and experience of members of the contractors' association. The ratings as to hazard are based on the experience of insurance companies as reflected in the current premium rates for workmen's compensation insurance, except in the case of composition roofers, who are not distinguished in the insurance rating manual from plate and tile roofers, whose work is far more hazardous.

The fourth column of the table shows the combined averages of the ratings for each craft, and the fifth column a scale of daily wages based on $7 for the carpenter, but recognizing a minimum of $3.50.

The table above is merely a tentative one, based upon as complete information as was at hand at the time of the compilation.

Highway Projects in Pennsylvania Under Way Total $51,731,524

The state highway department of Pennsylvania has completed approximately 160 miles of durable thoroughfare during the present season. During the week ending June 15, the department broke all previous records by completing 29.13 miles of highway in which concrete entered in some form. Its previous record was 27 miles in one week. So far during the 1921 season, nineteen road-building projects have been completed. These total 68 miles. A dozen other projects are rapidly nearing the completed stage.

On June 15 there were under way in Pennsylvania 231 construction jobs. These involved a total length of 4,946,-011 lin. ft., or 934.73 miles; and the total contract price is $51,731,523.54.

Increase in Car Loadings of All Commodities but Ore

An increase of 18,907 in the number of cars loaded with revenue freight during the week which ended on May 28, compared with the previous week, was shown by reports from the railroads throughout the United States just received by the car service division of the American Railway Association. The total for the week was 787,237 cars. This was 110,970 cars under that for the corresponding week in 1920 but 23,476 more than were loaded during the corresponding week in 1919.

Increases compared with the previous week were reported in the loading of all commodities except ore. The largest gain was made in the loading of grain and grain products, the total being 46,-337 cars, or 9,085 more than the previous week. A total of 164,870 cars were loaded with coal which was 6,358 cars greater than during the preceding week but 9,700 less than during the corresponding week last year.

Brindell Aides Get Prison Terms

Peter Stadtmuller and Joseph Moran, associates of Robert P. Brindell, convicted head of the Building Trades Council of New York City, were recently sentenced to serve indeterminate terms in the penitentiary of from six months to three years each. They had been found guilty of extortion and coercion, and their indictment resulted from investigations of the building industry in New York City made by the Lockwood joint legislative committee on housing.

Adjustments Made in Building Trade Wage Problems

During the past week several adjustments have been made in building trades wages that will tend to offer stabilization to building conditions in the respective communities. Though Newark, N. J., contractors have been operating on an open-shop basis for the past few weeks new conferences were held last week looking toward a reemployment of union labor in the principal skilled trades. Many union skilled trade mechanics have returned to work at the old scale pending the decision of the arbiter. Bricklayers, iron workers, carpenters and laborers, involved in the new conferences, were the first to return to work. Members of one of the local mason's unions of Rochester have returned to work, having accepted a 15 per cent reduction in pay. Such a reduction was included in the decision reached by the board of arbitration considering the matter.

The strike in Cleveland has virtually ended in the unions and contractors acceptance of an average wage reduction of 17 per cent, contained in the award announced by the general committee of twenty-one which arbitrated the controversy. The question of working rules and conditions is still to be settled. The award covers all classes except electrical workers, plumbers and bricklayers who submitted their disputes to independent arbitrators. Although several conferences have been held between representatives of the employer and employee in Cincinnati no decision has been reached which was considered equitable to both sides. The deadlock continues in Trenton, N. J., with the city commission taking a hand in an attempted settlement.

At a recent conference of the master builders' association of Baltimore decision was taken that commencing July 1 the standard wage of carpenters will be 75 cents per hour instead of 90 cents, the present wage. A similar step toward reduction was taken in the cases of several other crafts some time ago.

Calder Housing Bill Revised

By changing the wording of one of the items providing appropriations for the Bureau of Standards, the Calder bill proposing to set up a separate division of housing in that bureau has been superseded by a plan thought to be better adapted to meet the situation. It was demonstrated to the satisfaction of Senator Calder that housing involved so many studies that it would be impracticable to attempt to consolidate them into one division. Much of the Bureau of Standard's work has a bearing on constructional activities. Better results will be accomplished, it is be-

lieved, by allowing those activities to remain undisturbed as they are grouped, which will interfere in no way with the correlation of the results from each of the activities. This will be possible under the provision of the appropriation for continuing the investigation of structural materials by the inclusion of a separate clause which was added by the conferees on the second deficiency bill.

Contracts Must Be Awarded in Ten-Day Period After Bids

Judge E. B. Kinkead in the common pleas court of Franklin County has handed down a decision to the effect that the ten-day period within which the Ohio Highway Commissioner must award a contract is mandatory and not directory. This decision was handed down in the case of Henry P. Streicher, a contractor, suing as a taxpayer against Richard H. Shaffer and W. E. Dorsey, contractor, and State Highway Commissioner Leon C. Herrick. Mr. Streicher who was the low bidder on a stretch of road in Wyandot county, filed suit charging fraud in depriving him of the contract. His bid at that time was $134,104 when opened last August. In October the highway commissioner threw out all bids and readvertised the work. In November bids were opened and Mr. Streicher was found to be low at $102,941, on amended specifications. At the hearing Streicher abandoned his contention of fraud and went to trial upon his request for an injunction against the second contract claiming that it had to be awarded within 10 days according to law. His contention was upheld.

London Builders Initiate Dilution Plan of Government

(*London Correspondent*)

The London Master Builders and Allied Industries Association is endeavoring to assist in carrying out the government's dilution scheme which purposes to take into the building trades approximately 50,000 ex-service men. The master builders have posted notices wherever building operations are in progress which read:

"Notice is hereby given that on and after June 1, 1921, these works will be open so far as bricklayers, plasterers, slaters and tilers are concerned only to men who are willing to work with and assist ex-service men to learn the trade."

The dilution scheme has been approved and adopted by building trade employers throughout the country in order to help redeem the pledge given by the nation to ex-service men.

Southern Pine Shipments Exceed the Production

Shipment of lumber reported by the Southern Pine Association for the week ended June 10 exceeded production by 2.3 per cent. Orders however were 7.35 per cent below production which was 24.63 per cent below normal. The decrease of orders on hand during the week amounted to 2.87 per cent.

Seattle Street Program to Cost More Than $3,000,000

In the city of Seattle fifteen street improvements now under way, about to be let on contract, or in contemplation by the councilmen, mean the expenditure of at least $2,869,095 of the $3,384,813 called or by the general program. King County's local program calls for the expenditure of $530,087 on eight projects. The most important of the city's project is Elliott Avenue, estimated to cost, when paved, $600,253. Contract for the grading at $190,253 has been let. The improvement was demanded by the Port Commission, steamship companies and manufacturing plants in the district, but violently protested by the property owners, who assert that it amounts to confiscation of their properties.

Lubrication of Creeper Mounting Feature of New Erie

Erie steam shovels and cranes manufactured by the Ball Engine Company, Erie, Pa., are now being built with continuous-tread mounting that is fully lubricated. The new Erie mounting is an improvement arrived at after three years of experiment and tests. On the mounting every bearing is protected against wear by a film of special heavy oil, a lubricant which works equally well in hot or cold weather. The link bearings are not allowed to run dry and "cut" but are fully protected. The Ball Engine Company states that most of the trouble with various continuous-tread-type mountings for steam shovels has been directly due to lack of lubrication. Greater endurance and higher traveling speed and climbing power are claimed for the new Erie as a result of the reduction of friction in the gear

ERIE STEAM SHOVEL WITH CONTINUOUS-TREAD MOUNTING

mounting. The continuous-tread Erie travels at more than a mile an hour on high gear and climbs grades up to 25 per cent.

The lubrication is taken care of by filling the oil reservoirs which provide at least a month's steady supply. Once a month the operator spends an hour in going over all the mountings with a squirt gun. The continuous tread Erie is interchangeable with ordinary traction wheels or standard-gage car wheels of the same truck frame.

Would Investigate Cement Makers

In urging an additional appropriation of $35,000 for the study of certain products entering largely into building operations, the Secretary of the Interior, in a letter to Congress, states that there is the greatest necessity for investigating certain conditions in the cement trade. In his letter he states that his personal experience has led him to understand that there is undoubtedly an agreement between many of the cement producers for non-competition among them in certain territories. Since the government is a large purchaser of cement he suggests that it would be helpful to ascertain costs at different points in the United States. "This matter has been before the public in other forms," says Secretary Fall, "and you are aware that many of the cement manufacturers are under criminal indictment. We have been informed that a civil suit also has been filed against them."

Construction Analyzed by United States Chamber of Commerce

In a special report issued June 17 by the committee on statistics and standards of the United States Chamber of Commerce the total national wealth of the United States is estimated at $288,464,000,000, of which $77,321,000,000, or 26.8 per cent, is represented by the construction industry. The report presents an analysis of the relationship of construction to the basic industries of the nation, including manufacturing, mining, transportation, agriculture, trade and finance, and concludes that construction as a key industry should be classified separately as one of the nation's basic industries.

The report shows that in 1914 one-quarter of the 276,000 manufacturing concerns employing 10,658,000 workers, with an annual payroll of $5,368,294,000 and an annual output worth $25,000,000,000, was devoted to construction products.

In 1920, 90 per cent of all iron ore, copper and zinc, and 95 per cent of all lead mined was consumed by construction. Twenty per cent of the bituminous coal and 5 per cent of the anthracite coal mined was used by manufacturers of construction materials, by the railroads in transporting these products, and by traction lines and public service corporations in service to construction workers. A rough estimate of the value of these minerals is $4,400,000,000, engaging more than 1,000,000 workers at an annual wage of approximately $1,000,000,000.

Twenty-five per cent of the freight transportated by the railroads is construction materials.

Eleven million persons, either as workers or as members of workers' families, are estimated to derive their living from construction, either directly or through manufacturing and mining products used in the construction industry. The support given to agricul-

ture and to trade by the annual expenditures of this great number of persons is estimated at more than $5,000,000,000 for rent, fuel, food, clothing, furnishings, recreation, etc.

New capital issues during 1920 so far as reported totaled $4,545,000,000, consisting of state, municipal, railroad and industrial securities, of which it is estimated 50 per cent were issued for construction in one form or another.

The report concludes with the statement that construction is the barometer of conditions in all industry, is the first to be hit by depression and the first to be carried along on "the rising tide of prosperity." For that reason the plea is made for a better understanding of the industry's position.

Contracts Let for Four Weeks in June 8 Per Cent Over 1920

The value of contracts let, as reported in *Engineering News-Record*, for the first four weeks in June is $125,209,788, or $10,468,129 more than for the corresponding period of last year. This takes no account of the decrease in the cost of construction within the year, which decrease would make the 1921 figure at least $140,000,000. The greatest activity of this year is noted in street and road work and in miscellaneous building construction, the four-week figures in each of these classifications far exceeding last year's figures. The figures of 1920 were largely sustained by industrial work.

In street and road building this year's contracts for June so far have totalled about $53,000,000, whereas the figure for the same period of 1920 was approximately $31,000,000. In miscellaneous building work the respective figures were about: 1921, $36,500,000; and 1920, $31,000,000. The value of industrial contracts let in June, 1920, totalled in excess of $40,000,000, though this class of work this year has yielded a contract value only slightly in excess of $5,000,000.

In public works construction the value of contracts let shows much more stability than during last year. There appears to be a disposition to carry out well-defined programs of sewer and water-works projects.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 2, the next on July 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4.00	$4.50	$3.23	$3.51	$4.65	$4.35	$4.60	$5.00
Structural rivets, 100 lb	4.85	5.25	−5.75	4.88	5.30	−6.00	6.40	5.50	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.00	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65-5%	45%	58½%	51.9-5%	29%	49.80	47½%	5%
Cast-iron pipe, 6 in. and over, ton	54.00	59.22	65.00	54.10	62.80	70 00	85.90	65.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80(del.)	2.60	2.60	2.17	2.46	3.10	3.09	3.10	3.40
Gravel, ¾ in., cu.yd	2.50	−2.35	−3.00	2.25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	−1.40	−2.50	2.25	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	−2.25	2.80	2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	43.00	40.00	50 00	55.00	−36.00	47.00	27.00	28.50	110.00
Lime, finishing, hydrated, ton	21.00	−21.00	−25 00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	−1.50	− 2.75	1.65	1.50	3.10	2.25	2.75	1.00
Common brick, delivered, 1,000	18.40	11.50	−12.50	12.00	17 00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	.092	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	.1196	.15	+.98	.096	.092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	.78	.90	.87	.91	.95	.96	.79	.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.35@.45	.45	.50	.37½@.50	.50@.55	.50	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quote at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

The construction materials market is quiet, with no price changes in New York, Chicago, Montreal or San Francisco. The South, however, reports a number of price recessions. Sand and gravel are down in both Atlanta and Dallas, as are also hydrated and lump lime. Brick is off $2 in Dallas, the present quotation being $12.50. Crushed stone is down 25c. in Atlanta. Denver reports structural rivets down 25c. per 100 lb.

As to labor—In Chicago, on June 14, Judge Landis, arbitrator in building labor controversy, heard arguments from both sides and took the case under advisement. A decision is not expected before June 24. All construction that had been at a standstill is now going forward, with probably 20,000 working. The carpenters have refused to be bound by the arbitration, and open shop for carpenters is being considered.

In its last session, the Illinois legislature extended indefinitely the life of the commission which is investigating graft in Cook County, and appropriated $50,000 for the commission and $25,000 for the Attorney General.

Unemployment seems to be decreasing slowly but steadily in Denver. The strike and lockout in San Francisco has brought work almost to a standstill though builders claim resumption on several large projects and the return to work of 1,000 under the open-shop plan.